Registered at the G.P.O. for Transmission to Canada and Newfoundland by Magazine Post.

VOL. 28. Ser. A. Part 9. pp. 441–488. SEPTEMBER, 1940.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 3s. net.

IMPERIAL INSTITUTE OF ENTOMOLOGY.

Executive Council.

F. J. DU TOIT, *Chairman*, Union of South Africa.
Dr. WILLIAM ALLEN, *Vice-Chairman*, Canada.
Sir DONALD FERGUSSON, K.C.B., United Kingdom.
F. L. MCDOUGALL, C.M.G., Australia.
NEVILL L. WRIGHT, F.I.C., D.I.C., New Zealand.
J. M. ADAMS, F.R.C.Sc. (I), Eire.
D. JAMES DAVIES, C.B.E., Newfoundland.
SHAMALDHARI LAL, India and Burma.
B. F. WRIGHT, Southern Rhodesia.
J. A. CALDER, C.M.G., Colonies, Protectorates and Mandated Territories.
Sir DAVID CHADWICK, K.C.M.G., C.S.I., C.I.E., *Secretary*.

Director.

Sir GUY A. K. MARSHALL, C.M.G., F.R.S.

Assistant Director and Editor.

Dr. S. A. NEAVE, O.B.E.

Assistant Director and Superintendent of Farnham House Laboratory.

Dr. W. R. THOMPSON, F.R.S.

Head Office—British Museum (Natural History), Cromwell Road, London, S.W.7.

Publication Office—41, Queen's Gate, London, S.W.7.

HUTSON (J. C.). **A Note on the Cardamom Weevil** (*Prodioctes haematicus* **Chev. var.**).—*Trop. Agriculturist* **93** no. 5 pp. 281–283, 1 pl. Peradeniya, 1939.

In August 1939, several acres of cardamom plants on an estate in the Dolosbage district of Ceylon were found to be seriously infested by a variety of *Prodioctes haematicus*, Chevr., which has not previously been regarded as of economic importance in Ceylon. The adults and larvae of this weevil are briefly described. The former did not cause any appreciable injury to the plants, but made small feeding punctures and egg-pits in them. They occurred in tunnels in the stems in which they had emerged, in rolled leaves on the plants or on the ground at their bases. The eggs are probably laid anywhere in the softer tissues of the plants. The larvae tunnel in the stems and rhizomes, causing the plants to wither and die. They pupate inside the hollow stem or in enlarged cells in the rhizomes, and the young weevils remain for some time in the cell. The entire life-cycle probably lasts at least 4–6 weeks. Records of the weevil in Ceylon since 1900 are given ; nearly all are from districts in which cardamoms are grown.

For control, the destruction of all infested plants is recommended ; no pieces of rhizomes or roots should be left in the soil, but small heaps of this refuse material may be used to trap the weevils. Only sound rhizomes from a non-infested area should be used for replanting.

EVANS (J. W.). **Oak Insects.**—*Tasm. J. Agric.* **10** no. 4 pp. 199–205, 6 figs., 2 refs. Hobart, 1939.

Of the insects that attack oaks in Tasmania, the most important are the Aphid, *Myzocallis annulata*, Htg., and the Coccid, *Asterolecanium variolosum*, Ratz. [*cf. R.A.E.*, A **27** 21], both of which are apparently restricted to *Quercus robur* (*pedunculata*). The combined attack considerably weakens the trees. The Coccid infests the twigs and forms pits in the underlying wood. The females produce about 50 eggs, and at Hobart hatching has been observed to occur in mid-October. In New Zealand there are two broods a year [*cf.* **23** 281]. The crawlers move actively and are apparently able to feed only on new wood, since living Coccids have never been found on any but the current season's growth. *M. annulata* is abundant on the lower surfaces of the leaves. Reproduction is parthenogenetic and viviparous during the spring and early summer, but sexuales are produced towards the end of summer, and the females later lay eggs that overwinter on the oak branches. Hatching begins early in September, before any leaves have appeared, and is completed by the end of the month, when the trees are in full leaf. The first alatae appear in October.

Both pests can be controlled by spraying with red-oil or tar-distillate emulsion when the trees are dormant, but this is seldom practicable. The Encyrtid, *Habrolepis dalmanni*, Westw., was introduced into Tasmania in 1931–32 against *Asterolecanium* [*cf.* **21** 211] and is established in several districts [*cf.* **27** 21]. In 1937, Pteromalids were reared from examples of this Coccid collected at Launceston. *Myzocallis* is parasitised by *Aphelinus flavus*, Wlk., at Launceston and *Trioxys aceris*, Hal., in Hobart. Neither of them is indigenous to Tasmania. Both oviposit in the Aphids, the larvae feeding on the body contents and overwintering on fallen leaves within the parasitised hosts. *T. aceris* is itself attacked by a Hymenopterous parasite.

(1940) Wt. P4/3692 1700 10/40 S.E.R. Ltd. Gp. 432. [A] A

Coccinellids, chiefly *Leis conformis*, Boisd., and Chrysopid larvae are predacious on the Aphid.

Other pests of oak in Tasmania include the larvae of the Tineid, *Cryptophasa unipunctata*, Don., which bore into the wood, usually at the junction of two branches, and are controlled by cutting out and burning infested wood, and the mite, *Paratetranychus* (*Metatetranychus*) *pilosus*, C. & F., which is a pest of apple, but sometimes becomes numerous enough on oak to discolour the leaves.

Report of the Waite Agricultural Research Institute, South Australia 1937–1938.—120 pp., 3 pls., 10 graphs, 1 map. Adelaide, 1939.

A section of this report (pp. 40–48) deals with work on insect pests in South Australia during 1937 and 1938 and contains a survey of recent work on *Austroicetes cruciata*, Sauss., and *Chortoicetes terminifera*, Wlk. [*cf. R.A.E.*, A **24** 69; **26** 583, 703; **28** 332]. *C. terminifera* is considerably more adaptable to climate than *A. cruciata*, as it is present as a solitary grasshopper from Cape Jervis in the south to Birdsville in the north. A severe outbreak cannot occur, however, unless adequate rainfall during the warm months of two or more consecutive years in the outbreak area and in the intermediate breeding areas is followed by a season of comparative winter drought in the agricultural areas [*cf.* **25** 348].

Investigations on the apple thrips, *Thrips imaginis*, Bagn., showed that its threshold of development was about 8°C. [46·4°F.], that the prepupae and pupae cannot survive in soil containing less than about 10 per cent. moisture, and that pollen is necessary for the development of the immature stages and the production of eggs [*cf.* **24** 135]. It multiplies rapidly, therefore, only in the spring, when the conditions of temperature, humidity and nutrition are favourable. An outbreak is favoured by an early or warm autumn followed by an early warm spring with a few hot days during the flowering period of apple.

Information has been collected in recent years on the importance of insects that infest timber or attack *Pinus radiata*, the chief commercial timber crop. This pine is not severely damaged by insects in plantations, but trouble is sometimes caused in nurseries by the cutworm, *Euxoa radians*, Gn., and by *Phaulacridium vittatum*, Sjöst., which is common in some of the main pine plantation areas in the south-east, where the climate is cool and fairly moist. No injury to the growing trees by *Hylastes ater*, Payk., has been observed locally, though this Scolytid may be found in numbers in the forest in the bark of fallen logs, prunings and stumps. *Chermes* (*Pineus*) *boerneri*, Annand [*cf.* **27** 546] appears to be of little significance and to be restricted to trees that are below the general level of vigour. The Anobiid, *Ernobius mollis*, L., is sometimes found in the bark of dead standing trees, but usually occurs in the bark attached to structural timbers in mills and in the vicinity of forests, the larvae producing irregular galleries at the junction of the bark and the wood. *Lyctus brunneus*, Steph., infests included sapwood in hardwoods, particularly in furniture and interior woodwork. Serious damage to floorings and structural timbers is caused by *Coptotermes acinaciformis*, Frogg. [*cf.* **27** 545], which is extremely common and also attacks lead sheaths of underground telephone cables and goods stored in cellars and basements; the activity of this termite is particularly associated with local moist

conditions, such as leaking waterpipes, and is encouraged by unsuitable types of buildings.

Encarsia formosa, Gah., was liberated in glasshouses near Adelaide against *Trialeurodes vaporariorum*, Westw., on tomatos ; it established itself very rapidly and completely controlled its host. Reports indicate that this Aphelinid is widely distributed in the tomato-growing areas and invariably keeps the Aleurodid under control.

PESCOTT (R. T. M.). **The Argentine Ant** (*Iridomyrmex humilis* **Mayr**). —*J. Dep. Agric. Vict.* **37** pt. 12 pp. 561–562, 586, 3 figs., 2 refs. Melbourne, 1939. [Recd. 1940.]

In view of the fact that *Iridomyrmex humilis*, Mayr, which has not previously been recorded from Australia, has recently become established in several areas round Melbourne, where it was probably introduced in packing material, notes are given on the habits of this ant, its economic importance, distribution, method of spread and control, and characters enabling the worker to be distinguished from those of native species are briefly described. It is emphasised that control will be effective only if it is carried out relentlessly and directed against the queens in the nests. Recommendations include the use of a syrup bait poisoned with sodium arsenite, of which the formula is similar to that already noticed [*cf. R.A.E.*, A **23** 171 ; **24** 771]. Fumigation of the nests with carbon bisulphide, and the application to them of creosote or kerosene are practicable only in small areas, such as round the foundations of houses or in gardens, as the nests are usually small, numerous and difficult to find. Removing leaf débris is of value, as the ants prefer situations where leaves have accumulated.

CHAMBERLAIN (E. E.). **Turnip Mosaic. Extended Host Range and Identity**—*N.Z. J. Sci. Tech.* (A) **21** no. 4A pp. 212A–223A. 7 figs., 8 refs. Wellington, N.Z., 1939. [Recd. 1940.]

Further investigations in New Zealand in 1936–37 on the host range of turnip mosaic have shown that, in addition to the plants already noticed [*R.A.E.*, A **25** 260], the virus also occurs in the field in stock (*Matthiola incana*), wallflower (*Cheiranthus cheiri*) and white mustard (*Sinapis alba*). In experiments, the virus was transmitted by means of *Myzus persicae*, Sulz., or mechanically from infected turnips or swedes to 11 species of cruciferous plants and back from 8 of these to swedes or turnips. It was also transmitted mechanically to *Nicotiana glutinosa*. Symptoms have not been observed in the field on any of the experimentally infected cruciferous weeds, but several Aphids, including *M. persicae*, overwinter on them. It is therefore considered probable that some of these weeds become infected during the summer and autumn and that infected Aphids migrating in spring from them to cruciferous crops transmit the virus to the latter. The symptoms in naturally infected stock, wallflower and white mustard and in *N. glutinosa* and 8 of the artificially inoculated crucifers are described.

Studies on the physical properties of the virus showed that it remains viable *in vitro* for two but not three days, tolerates dilution to 1 : 100 but not to 1 : 1,000, and is inactivated after exposure for 10 minutes to temperatures between 55 and 60°C. [131 and 140°F.].

The insect vectors, physical properties and host range of the virus of turnip mosaic in New Zealand and of the viruses of 7 diseases that

attack cruciferous plants in the United States are compared. It is concluded that New Zealand turnip mosaic resembles black ring of cabbage in methods of transmission, insect vectors, physical properties and host range, but differs from it in the symptoms produced. Black ring occurs in the United States in cabbage, cauliflower, broccoli and brussels sprouts in the field, and is transmitted by *M. persicae* and *Brevicoryne brassicae*, L. Its symptoms are chlorotic and necrotic rings on the foliage.

CHAMBERLAIN (E. E.) & BAYLIS (G. T. S.). **The Occurrence of Onion Yellow-dwarf in New Zealand.**—*N.Z. J. Sci. Tech.* (A) **21** no. 4A pp. 229A–236A, 4 figs., 13 refs. Wellington, N.Z., 1939. [Recd. 1940.]

A localised outbreak of a virus disease identified as onion yellow-dwarf, caused by *Allium* virus 1, occurred in November 1938 in onions in seed-crops grown from local bulbs near Christchurch, New Zealand. This disease has previously been recorded from the United States [*R.A.E.*, A **20** 357; **21** 605; **24** 560], Germany and Russia, but not from New Zealand, and the literature dealing with it is briefly reviewed. The symptoms in New Zealand were similar to those described from the United States and Germany, and diseased bulbs were considered to show increased susceptibility to storage rot. The percentage of plants infected reached 45 in one of three seed-crops examined in November 1938 and exceeded 50 in the main crop in the following February.

In the laboratory, the virus was successfully transmitted from infected to healthy onion by abrasion, with an incubation period of 12 days, and by *Macrosiphum solanifolii*, Ashm., *Aphis laburni*, Kalt., *Myzus persicae*, Sulz., and a closely related species of *Myzus* that is common in New Zealand. Aphids bred in the insectary were allowed to feed on infected onion plants for one hour and were then transferred to young healthy plants enclosed in muslin. The cages were removed after 7 days, when all the Aphids were dead, since onion is not a suitable food-plant. Symptoms appeared on the plants 10 days after *Myzus persicae* and *A. laburni* were placed on them. The virus was also transmitted to shallots by *M. persicae* and by abrasion, and the symptoms resembled those on onion.

The virus exists only in growing plants or dormant bulbs and was able to survive the winter in the latter. Seed-crops appear to be the chief source of infection, and the disease was most severe in main crops growing close to heavily infected seed-crops. To eradicate the disease, restrictions are being temporarially enforced requiring the destruction of all stray bulbs left in the ground after harvest and prohibiting the cultivation in the affected area of onion seed-crops and shallots and restricting the cultivation of jonquils (*Narcissus jonquilla*), which might also act as reservoirs of the virus, as they have been experimentally infected in the United States.

COUTURIER (A.). **Remarques sur la biologie de** *Ceresa bubalus* **Fab. Membracide d'origine américaine.**—*Rev. Zool. agric.* **37** no. 10 pp. 145–157, 5 figs., 31 refs. Bordeaux, 1938. [Recd. 1940.]

Accounts, largely based on the literature, are given of the bionomics and distribution of *Ceresa bubalus*, F. [*cf. R.A.E.*, A **12** 444; **16** 569; **19** 423; **22** 349; **26** 343; **27** 390], and the adult and nymph

are briefly described. In France, the author has observed the eggs of this Membracid on grape vine and some 20 different trees and shrubs, a list of which is given. They are laid in summer in slits in the bark of trees 1–2 years old, or on the young branches of woody plants, and hatch in the following spring. Many of the eggs do not hatch and are probably killed by the pressure of the plant tissues ; moreover, they are very sensitive to dry conditions and do not survive on branches that are cut or broken off. The newly hatched nymphs sometimes suck the young buds for a short time, but soon descend from the trees to the stems of herbaceous plants, particularly leguminous ones. In breeding experiments, they required very fresh plants and abandoned broad bean plants (*Vicia faba*) two days before these began to turn yellow. The duration of the nymphal stage is dependent on the food-plant and temperature, but on an average it is completed in two months. At 27–28°C. [80·6–82·4°F.] development was rapid in the first three instars, but mortality was high in the last two. The life-cycle was completed normally at 19–20°C. [66·2–68°F.]. Little attention has so far been given to the injuries caused by nymphal and adult feeding, which generally occurs on the stems and rarely on the leaves of the food-plant. The bugs move very little once they have become established ; a black ring appears at the site of feeding, plant cells are killed, and this dead tissue stops the circulation of the sap. The stems of herbaceous plants frequently break off at the site of feeding. The chief injury, however, is that caused to trees by oviposition.

In France, this Membracid has not as yet caused widespread damage. Control measures include clean cultivation of nurseries, especially in May, June and July, when the nymphs are present, and destroying the eggs by early pruning or spraying with mineral oils [*cf.* **16** 569]. Leguminous plants should not be cultivated near fruit trees.

FEYTAUD (J.). **La méthode biologique dans la lutte contre le doryphore (*Leptinotarsa decemlineata* Say).**—*Rev. Zool. agric.* **37** no. 11 pp. 161–165. Bordeaux, 1938. [Recd. 1940.]

A brief survey is given of work in France on the control of *Leptinotarsa decemlineata*, Say, on potato by biological means. These include the cultivation of hybrids between potato and *Solanum demissum* that repel ovipositing females or are resistant to larval feeding [*cf. R.A.E.*, A **27** 107, 169, 357 ; **28** 277] and the introduction of parasites and predators [*cf.* **26** 594, 595]. The rôle played by vertebrates, such as toads, snakes, lizards and various birds [*cf.* **24** 757], in controlling infestations is mentioned.

CHABOUSSOU (F.). **Remarques sur *Lebia grandis* Hentz.**—*Rev. Zool. agric.* **37** no. 11 pp. 165–171. Bordeaux, 1938. [Recd. 1940.]

Brief descriptions are given of the adults and the process of larval development of *Lebia grandis*, Hentz, which was introduced into France from North America against *Leptinotarsa decemlineata*, Say, on potato [*cf. R.A.E.*, A **25** 365]. In the laboratory, this predacious Carabid attacked the eggs, larvae and pupae of *L. decemlineata* and appeared to be closely associated with it, as the only other insects accepted by it were the larvae of an unidentified Noctuid and those of *Crioceris asparagi*, L. Oviposition occurred at temperatures of not less than about 25° [77° F.], and the eggs were laid singly on the soil and

covered with particles of sand or humus. The Carabid is prolific, and two females, one of which died prematurely, gave rise to over 2,600 larvae. The newly hatched larvae burrowed into the soil in search of the larvae and pupae of *Leptinotarsa*, and at 25°C. the larval and pupal stages together lasted 20–25 days [*cf.* **25** 648].

The technique of rearing the Carabid is described. Adults were placed in containers filled to three-quarters of their capacity with sterilised vegetable mould, which was moistened with sterilised water, and kept in an incubator at 30°C. [86°F.]. The larvae were transferred individually to test tubes of 1 cm. diameter and 12 cm. high filled almost to the top with sterilised mould of 16–18 per cent. moisture content into which a full-fed larva of *Leptinotarsa* had burrowed 2–4 hours previously for pupation. The tube was then stopped with cotton-wool and kept at 25°C. The larvae of the Carabid invariably entered the soil in search of *Leptinotarsa*, and the resulting adults made their way to the surface, where they were collected. By this method, adults were obtained from at least 70 per cent. of the larvae of the Carabid, and over 3,000 adults were bred during the season.

The author considers that the possibility of establishing the Carabid in France is limited, owing to the high temperatures required for oviposition and the high humidity of the soil necessary for survival. It may, however, become established in localities in which favourable conditions of humidity exist. Adults liberated in a district of south-western France have given rise to several successive generations.

Trouvelot (B.). **État actuel des recherches sur les solanées tubérifères résistantes au doryphore.**—*Rev. Zool. agric.* **37** no. 12 pp. 177–180. Bordeaux, 1938. [Recd. 1940.]

The author briefly reviews work in France in the period 1932–38 on the production by means of crossing with other tuberiferous species of *Solanum* of potatoes resistant to attack by *Leptinotarsa decemlineata*, Say [*cf. R.A.E.*, A **27** 357, etc.].

Busnel (R. G.) & Chevalier (M.). **Notes sur la microphysiologie du *Leptinotarsa decemlineata* Say à l'état larvaire. Étude du comportement des larves pendant leur croissance sur *Solanum demissum* et sur les hybrides de cette race.**—*Rev. Zool. agric.* **37** no. 12 pp. 180–187, 2 graphs, 3 refs. Bordeaux, 1938. [Recd. 1940.]

An account is given of laboratory observations in France on the larval development of *Leptinotarsa decemlineata*, Say, on *Solanum demissum*. The larvae were reared at 23°C. [73·4°F.] and a relative humidity of 80 per cent. on the terminal shoots of young plants; fresh shoots were supplied every day, and the containers were exposed to bright daylight. Larvae that hatched from eggs artificially transferred to *S. demissum* fed on the lower epidermis of the leaves. They consumed a very small amount of this, however, and then began to wander aimlessly over the plants, finally abandoning them. The resulting mortality in some cases reached 99·8 per cent. Larvae that were transferred to *S. demissum* in the second instar remained on the plants and some of them completed their development. Graphs are given showing for batches of 10 larvae on potato, *S. demissum* and a resistant and a slightly resistant hybrid of the two the average durations of development, the average weights of

the larvae and pupae and the average areas of leaf consumed. The duration of the larval stage averaged 19, 16 and 9 days on *S. demissum* and the two hybrids, respectively, as compared with 9 days on potato. The weight of the full-fed larvae averaged only 40, 60 and 85 per cent., respectively, of that of larvae on potato, and they gave rise to undersized adults. This protraction of development on *S. demissum* was apparently due to insufficient feeding, since the amount of foliage consumed was only 2½ per cent. of that on potato [*cf. R.A.E.*, A **28** 277]. Periods of feeding on *S. demissum* are short and interrupted by periods of torpor [*cf. loc. cit.*]. The larvae avoid light and shelter from it on the lower surfaces of the leaves. The development of larvae on *S. demissum* varied considerably within a single batch. The percentage mortalities among larvae reared on potato, *S. demissum* and the two hybrids were 10, 80, 55 and 35, respectively. In the case of *S. demissum* and the hybrids, mortality was highest in the third instar. The physiological changes that take place in the larvae when feeding on *S. demissum* are briefly discussed, and it is concluded that they render larval development very precarious.

CHARDENON (J.). **Le comportement du doryphore en plein champ vis-à-vis de diverses espèces de solanacées et notamment des Nicotianae.**—*Rev. Zool. agric.* **37** no. 12 pp. 187–190. Bordeaux, 1938. [Recd. 1940.]

In view of the possibility of the spread of *Leptinotarsa decemlineata*, Say, from potato in the Dordogne to tobacco plantations in south-western France, field observations were carried out at Bergerac on the attractiveness to the Chrysomelid of various solanaceous plants, with special reference to those of the *Nicotiana* group. As a result of these investigations, systematic lists are given of plants that are not attacked by the pest and of those that are infested. The latter are subdivided into three groups, comprising plants of medium attractiveness, on which most of the larvae die and the damage caused is not severe ; those that are attractive to the adults, but which are either toxic or are provided with protective spines that cause considerable mortality among the larvae ; and plants of maximum attractiveness, on which the adults are abundant and the larvae find optimum conditions for development. The aerial parts of plants of this last group are entirely consumed ; they comprised potato, egg-plant (*Solanum melongena*) and several other species of *Solanum*. There is, however, no clear demarcation between the groups, as some plants that were only slightly infested in one year were severely attacked in the following one. Of the *Nicotiana* group, only ornamental tobaccos were infested, and injury to them was slight. Varieties of tobacco cultivated for leaf were not attractive to the beetle.

COUTURIER (A.). **Les asopides et le doryphore.**—*Rev. Zool. agric.* **37** nos. 11–12, pp. 171–176, 190–192, 1 fig., 2 graphs, 14 refs. Bordeaux, 1938. [Recd. 1940.]

Brief notes based on the literature and original observations are given on the bionomics of Pentatomids that attack *Leptinotarsa decemlineata*, Say, on potato. Of these, *Auriga* (*Arma*) *custos*, F., *Zicrona coerulea*, L., and *Picromerus bidens*, L., are indigenous in France, and *Podisus maculiventris*, Say, and *Perilloides* (*Perillus*) *bioculatus*, F.,

have been introduced from the United States and reared in captivity [*cf. R.A.E.*, A **20** 561 ; **26** 595]. *A. custos* apparently produces only one generation a year. Oviposition does not occur at temperatures below 20°C. [68°F.], and in the laboratory the egg stage lasted 10–11, 7–8 and 6 days at 22–23°C. [71·6–72·4°F.], 27–28°C. [80·6–82·4°F.] and 32–35°C. [89·6–95°F.]. A female taken in the field at the end of May laid 300 eggs in two months. Individuals that emerged in July and were induced to oviposit before the winter died after having laid a few eggs. The bug was several times observed by the author on alder infested by the Galerucid, *Agelastica alni*, L. *Z. coerulea* seems to have become more abundant in the south-west and west of France since the appearance there of *L. decemlineata*. It has two generations a year, and the females deposit about 50 eggs. *Picromerus bidens*, which is an important predator of sawfly larvae in Germany [*cf.* **25** 281], is rather scarce in France ; it has two generations a year, and the females lay about 300 eggs each. The information on *Podisus maculiventris* has already been noticed [*cf.* **26** 595, 596]. Observations on *Perilloides bioculatus* [*cf.* **26** 595] showed that oviposition does not occur below 28°C., the threshold of development is reached at 20°C., and the adults enter a diapause at 15°C. [59°F.].

Mayné (R.). Ed. **Comptes rendus de la IVième Conférence du Comité international pour l'Etude en commun de la Lutte contre le Doryphore. Wageningen, les 2, 3 et 4 février 1939.**—*Versl. PlZiekt. Dienst Wageningen* no. 94, 95 pp., 1 graph, 1 map. Wageningen, 1939. [Recd. 1940.]

Reports were presented at this conference on the spread of *Leptinotarsa decemlineata*, Say, in 1938 on potato in Germany [*R.A.E.*, A **27** 160, etc.] ; Belgium [*cf.* **26** 719] ; France [**27** 350] ; Luxemburg ; Holland [**28** 278, etc.] ; and Switzerland [**27** 350]. The following are brief summaries of the papers read.

Feytaud (J.). La recherche d'engrais insecticides (pp. 45–46). Further tests in 1938 of the mixture of fish manure and certain chemical fertilisers advocated against *Leptinotarsa* fully confirmed the negative results obtained in 1937 [*cf.* **26** 412]. Calcium cyanamide [**27** 107, etc.] had no effect on pupating larvae when applied to the soil at rates usual in agriculture (135–450 lb. per acre), but when the rate of application was increased to 990–1,080, 2,025–2,160, and 3,375–3,600 lb. per acre, the percentage mortalities were 84, 95·3 and 97·4 ; that in untreated soil was 46·6. In addition to the lethal effect on the larvae, pupation was retarded for periods that sometimes exceeded 24 hours, and although some of the larvae were able to pupate, few of them gave rise to adults.

Trouvelot (B.). Les recherches faites en 1938 sur les plantes résistantes aux attaques du doryphore (pp. 46–49). Further investigations in 1938 carried out in collaboration with German workers confirmed the results obtained in 1937 [*cf.* **27** 107], and the breeding of hybrids resistant to *L. decemlineata* was begun. *Solanum demissum* was still the most satisfactory species for crossing with potato, but certain hybrids of *S. chacoense* were promising. It was observed in the field that resistant hybrids neither attracted nor repelled *Leptinotarsa* more than others. With the best hybrids, resistance in the field to larval development is equal to that of *S. demissum*, and one such

hybrid yielded a crop of tubers that amounted to half that of the potato check plants. Females that had fed exclusively on *S. demissum* for several weeks failed to oviposit even after removal to potato. Spectrographic examination of paper impregnated with the juice or extract of *S. demissum* revealed a special fluorescent band peculiar to this plant and closely related hybrids of it. The substances that confer resistance on *S. demissum* are apparently closely connected with its vegetative and physiological condition. Plants under glass were less resistant than others of the same type growing in the field, and when leaves were partly covered with tinfoil, such protected parts were more readily eaten by the larvae. Young plants and leaves were more attacked than old ones, and oviposition on *S. demissum* occurred chiefly on young plants. It appears probable, therefore, that the noxious substance is connected with the chlorophyll, and that it may be present in greater concentrations in the less juicy parts of the plant.

Schwartz (M.). Bericht über die von Dr. Sellke im Jahre 1938 in Ahun (Creuse) durchgeführten Arbeiten. Prüfung der Resistenzeigenschaften von Kartoffelhybriden [Report on the Work done by Dr. Sellke at Ahun in 1938. Tests of the Resistance of Potato Hybrids] (pp. 49–52). Investigations on the resistance to larvae of *L. decemlineata* of hybrids of potato and various wild species of *Solanum* from Germany [*cf.* **27** 107] showed that hybrids between potato and *S. demissum* were the most resistant, but the degree of resistance varied in plants of a single batch, and all varieties of *S. demissum* were not equally valuable.

Schwartz (M.). Versuche mit chemischen Mitteln [Experiments with Insecticides] (pp. 52–53). The experiments by Sellke reported in this paper have been noticed from another source [*cf.* **27** 634].

Feytaud (J.). Les vols du doryphore de 1938 en France (pp. 53–55). Details are given of flights of *L. decemlineata* in France in 1938, confirming the author's view that this means of spread is more important than any other.

Feytaud (J.). Le doryphore, les obstacles et le climat (pp. 55–59). The author states that infestation by *L. decemlineata* is spreading in Europe at the rate of about 30 miles a year and is not permanently arrested by either mountains [*cf.* **27** 583] or water. The adults can float on water for a long period [*cf.* **28** 388] and survive without food for months. Temperatures rising to 25–30°C. [77–86°F.] stimulate them to flight.

Schwartz (M.). Untersuchungen zur Frage der Schädigung von Bienen durch Arsenspritzungen gegen den Kartoffelkäfer [Investigations on the Question of Injury to Bees by Arsenical Sprays used against the Potato Beetle] (pp. 59–62). Field observations in western Germany in 1938 showed that the use of arsenical sprays against *L. decemlineata* on potato involved some risk of poisoning honey bees. In the ensuing discussion, Dr. Feytaud stated that fowls and other poultry are very occasionally poisoned in France as a result of spraying with arsenicals. Such cases are mainly due to negligence [*cf.* **24** 757].

Feytaud (J.). Le doryphore comme test pour l'épreuve d'insecticides (pp. 62–65). Brief descriptions are given of the methods by which fourth-instar larvae of *L. decemlineata* are used in south-western France as test insects for comparing the toxicity of stomach and contact insecticides [*cf.* **28** 387] and of the technique by which the predacious Carabid, *Lebia grandis*, Hentz, was bred in the laboratory in France [*cf.* **28** 446].

Mayné (R.). Etendue des traitements prophylactiques. Mesures de lutte directe (pp. 66–71). The best preventive measure against *L. decemlineata* is to spray all potato fields with diplumbic lead arsenate or calcium arsenate, but in districts in which infestation is generalised the lead arsenate can be combined with Bordeaux mixture (1 lb. in 10 gals.), which somewhat reduces the toxicity of the arsenical but acts as a fungicide and confers a certain repellent quality on the spray. In cases in which infestations consist chiefly of larvae or occur in situations in which the use of arsenicals is dangerous, dusts or sprays of nicotine or rotenone should be used.

Schwartz (M.). Zur Frage der Beschaffenheit der Kalkarsenate für die Kartoffelkäferbekämpfung [The Composition of Calcium Arsenates for Use against the Potato Beetle] (pp. 71–73). The official standards adopted in Germany for the authorisation of calcium arsenates for use against *L. decemlineata* [*cf.* **27** 115] are briefly discussed.

Tilemans (E.). Les insecticides du doryphore (pp. 73–87). The author discusses the physical and chemical properties that are desirable in arsenical sprays and dusts for use against *L. decemlineata* and refers briefly to the possibility of using insecticides other than arsenicals.

Vayssière (P.). **Principes de Zoologie agricole.**—17 × 11 cm., 223 pp., 24 figs., 3 pp. refs. Paris, A. Colin, 1940.

This book shows the scientific and economic importance of studies on animals beneficial and harmful to crops. It deals mainly with Arthropods, but includes short sections on mice and Nematodes. It describes the resistance of the plant to attack, the effect on the pests of temperature, humidity and other climatic factors, combined or singly, and the dispersion and distribution of species injurious to crops and includes a separate chapter on the migratory locusts. Cultural and biological methods of control, and control by means of heat, cold, fire, water or pressure, and by the use of chemical products are discussed. In conclusion, the author urges the necessity for an improved plant protection service for France and the French colonies, which should prevent the importation of phytophagous insects and the increase of those already introduced. A bibliography is appended.

The Depletion of Starch from Timber in Relation to Attack by *Lyctus* Beetles.

Parkin (E. A.). **III. A Second Experiment upon the Girdling of Standing Oak Trees.**—*Forestry* **12** no. 2 pp. 117–124, 1 fig., 2 refs. London, 1938.

Parkin (E. A.) & Philips (E. W. J.). **IV. A Third Experiment on the Girdling of Standing Oak Trees.**—*Forestry* **13** no. 2 pp. 134–145, 4 refs. 1939. [Recd. 1940.]

Since a preliminary experiment in which four oaks were girdled [*cf. R.A.E.*, A **26** 635] indicated that this method of rendering the sapwood free from starch, and so immune from attack by beetles of the genus *Lyctus*, had practical possibilities, a further experiment, described in the first paper, was carried out [*cf.* **26** 707]. Twenty standing oaks (*Quercus robur*) in Herefordshire were girdled in April 1937 through bark, phloem and cambium about 20 feet above the ground and felled in January 1938. Depletion of starch from the sapwood below the girdle was recorded in all the treated trees, but

considerable variation was observed between different trees and between different parts of the same tree. At the time of felling, 3 trees still contained sufficient starch to be considered definitely liable to *Lyctus* attack, while 9 were classed as non-susceptible and 8 as partly susceptible.

In the second paper is described a still further experiment to study the variation more closely. Twenty oak trees in Hampshire were girdled in three different ways at a height of 16 feet above the ground, 10 in May and 10 in July 1938; the trees were not felled, but borings were taken at intervals up to March 1939. Considerable variation in starch depletion was again recorded between different trees and different parts of the same one. Depletion continued until January 1939, at which time there was no difference in starch losses between the trees treated in May and July. The type of girdle is unimportant so long as the bark is cleanly removed from a ring 6–8 inches wide. The final classification of the trees with respect to the susceptibility of the timber to attack by *Lyctus* was the same as in the previous experiment. Narrow sapwood, high recent growth, a vigorous but compact crown, and a long clean bole free from epicormic shoots are characters that appear to favour depletion.

It is concluded that unless further depletion can be achieved, possibly by storing the logs for a few months before conversion, the method of girdling cannot be considered sufficiently reliable for general commercial use, because there may be a small percentage of trees in which the starch content is reduced more slowly than in the others. However, the treatment could probably be successfully applied to selected trees.

Report of the Forest Products Research Board for the Year 1938.—Med. 8vo, iv+84 pp., 4 pls., 12 figs. London, H.M.S.O., 1940. 1*s.* 6*d.*

Part of this report (pp. 43–53) is concerned with the results of research connected with wood-boring insects in England in 1938, some of which have already been noticed [*cf. R.A.E.*, A **26** 632; **28** 435; and preceding abstract]. Work on the four methods of reducing the starch content of timber [*cf.* **26** 707] in order to render it unsuitable for the development of the larvae of beetles of the genus *Lyctus* was continued. Borings taken from 50 representative logs of English oak stored in the round indicated that, with very few exceptions, the starch content of winter-felled logs will have fallen by the end of the following autumn to a level below that required for successful infestation by *Lyctus*. Observations on barked logs stored in water showed that the rate of starch depletion varied with different timbers, being much slower in walnut than in oak or ash. Examination of a few barked logs of oak, elm and ash that had been stored in sea-water in a tidal basin indicated that starch was still present in them in appreciable quantities even after 5 years' immersion. In ash boards treated in a kiln, chemical staining was so marked as to spoil the appearance of the timber. This method cannot therefore be considered suitable for reducing starch in ash unless some means of avoiding the staining can be devised. Attack by *Lyctus* on seasoned oak sapwood was prevented by immersion for 5 minutes in a neutral tar oil, a low boiling creosote oil or a proprietary preservative of the creosote type; approximately 2 weeks was allowed to elapse between treatment and exposure to attack. A further series of tests was carried

out with a 5 per cent. aqueous solution of potassium chromate using a wider range of absorption than in previous work [*cf.* **26** 190]; samples of oak sapwood were immersed for periods varying from 5 minutes to 24 hours, and exposed to attack by *Lyctus* one week later, but none of the treatments proved effective, possibly on account of the poor penetration obtained. The addition of a wetting agent did not improve penetration, which was, however, increased by maintaining the wood at 130°F. for half an hour before immersion.

It was found possible to rear larvae of *Xestobium rufovillosum*, DeG., so that their development could be observed, by using thin sections of decayed sapwood held between two glass plates and kept under suitable conditions of temperature and humidity. Some of the most important results of experiments that became available in 1938 were those concerning the relation between the rate of development of the beetle and the type and extent of fungous decay in timber. In experiments in which the temperature was 22°C. [71·6°F.] and the moisture content 18–20 per cent., the duration of the life-cycle in samples of oak sapwood that had lost weight through decay due to *Phellinus cryptarum* before exposure to attack increased from 12 months or less when the percentage loss in weight was 75–50 to 2½–3 years when it was 34–26. When the percentage loss was 22–16, attack was in progress but no emergence had occurred after 3½ years, and when it was nil no attack developed. Similar results were obtained with willow decayed by *Polystictus versicolor* and kept under the same conditions, but the extent of decay appeared to have less effect than in oak sapwood, and the duration of the life-cycle was, in general, shorter than in oak. The influence of moisture in rendering severely decayed wood suitable for attack was clearly shown by an experiment carried out at 23°C. [73·4°F.] on oak sapwood decayed by *Phellinus cryptarum*; when the percentage moisture content was 8 the attack died out, when it was 10 the life-cycle was not completed after 3½ years and when it was 13–14·5 and 16–18 it lasted 29 and 15–16 months [*cf.* **26** 191]. A rise or fall in moisture content caused a corresponding acceleration or retardation in the rate of larval development. The effect of temperature is illustrated by the fact that at 22°C. and in severely decayed oak sapwood of 18–20 per cent. moisture content, the life-cycle lasted 17 months, whereas when the wood was kept out-of-doors but protected from rain and sun, it lasted 3 years, although the moisture content averaged 18 per cent. It is concluded that warm, moist conditions favouring the development of decay, such as occur in an ill-ventilated roof, are more conducive to infestation than the dry, cool conditions prevailing in a sound well-ventilated structure. The larvae bore more rapidly, cause more destruction and reach maturity earlier in severely than in moderately decayed wood, but it was found that as fungous decay becomes more advanced, they digest a much smaller proportion of the wood that they comminute. It appears that the function of the fungus in this type of biological succession consists not so much in predigestion (by breaking down the components of wood into simpler substances), as in the weakening of the structure by chemical decomposition, so that the larvae encounter less resistance when boring. There are indications that the larvae reject or fail to digest a larger relative proportion of mycelium than of decayed wood, even though the mycelium probably contains sufficient nitrogen to satisfy the requirements of as many larvae as the samples can support.

From information obtained in timber yards, it is evident that in southern England infestation by *Platypus cylindrus*, F., has reached serious proportions. This pin-hole borer can penetrate the heartwood as well as the sapwood of oak logs and green timber of large dimensions stacked for air-seasoning. Infestations were observed both in woods and in timber yards during July and August. A further experiment on fumigation as a means of sterilising timber and furniture infested by insects [*cf.* **26** 190] was carried out in a commercial fumigation chamber, in which samples of ash 1-inch thick infested by *Lyctus brunneus*, Steph., and blocks of elm and beech 1–3 inches thick attacked by *Ptilinus pectinicornis*, L., were fumigated with hydrocyanic acid gas. The results suggest that the more severely attacked the wood, the better the penetration obtained, and that with an initial concentration of 28·7 mg. per litre in the chamber, the amount of HCN entering the wood during an exposure of 4½ hours at a temperature of 70°F. is sufficient to kill most, if not all, the larvae in infested furniture. The rate of progress of damage could therefore be greatly reduced, and a second treatment after an interval of a year should eradicate infestation.

Holman (H. J.). Ed. **A Survey of Insecticide Materials of Vegetable Origin.**—Med. 8vo, viii+155 pp., 372 refs. London, The Imperial Institute, 1940. Price 3*s.* 6*d.*

This survey was compiled in view of the fact that the production of insecticide materials derived from plants is of increasing importance in various parts of the British Empire and that information on their sources and production and the trade in them is not readily available. An outline is given of recent work in various countries on the chemical and insecticidal aspects of this group of plant products, together with references to the more important literature dealing with this subject, the cultivation of the plants and the preparation of the derived products. The book is divided into five parts, of which the first deals with plants containing alkaloids, particularly nicotine and anabasine, the second with the plants containing rotenone, including *Derris* and species of *Lonchocarpus* known as cubé etc., and the others with pyrethrum, quassia and plant oils. The subjects reviewed in each part include the physiological action of the product, the insects against which it has been used and the forms in which it is applied.

Lovászy (P.). **Some Notes on the Insect Parasites of** *Diprion polytomum* **Htg. (Hymen., Tenthredinidae).**—*Ann. ent. fenn.* **5** no. 3 pp. 225–233, 7 figs., 8 refs. Helsingfors, 1939. [Recd. 1940.]

Very brief notes are given on the rapid spread of the sawfly, *Gilpinia* (*Diprion*) *polytoma*, Htg., on spruce in eastern Canada and the north-eastern United States since its discovery there in 1930 [*cf. R.A.E.*, A **20** 590; **23** 236; **25** 511, etc.] and of the attempt to control it by importing insect parasites from Europe [*cf.* **25** 12; **26** 103]. With a view to obtaining data on the parasites of the sawfly in Finland, 100 larvae were collected in August 1939 in the west of Finnish Lapland. Of these, 22 and 7 were parasitised by the Ichneumonids, *Lamachus* sp. and *Holocremnus ratzeburgi*, Tschek, respectively, and 5 and 6 by Tachinids identified as *Sturmia inconspicua*, Mg., and *Ptychomyia selecta*, Mg. Cases of superparasitism were observed.

Details are given of the morphology of the Tachinid larvae. Except in one case, all the Ichneumonids were in the egg stage, which probably indicates that they usually hatch during the prepupal stage of the host in the cocoon.

GOIDANICH (A.). **A proposito della Zigena della vite** (*Theresimima ampelophaga* **Bayle-Barelle**) **in Italia.** [The Grape-vine Zygaenid, *T. ampelophaga*, in Italy.]—*Boll. Soc. ent. ital.* **72** no. 1 pp. 3–9, 11 figs., 29 refs. Genoa, 1940.

The author reviews the generic nomenclature of this Zygaenid and agrees that the correct name for it is *Theresimima ampelophaga*, Bayle [*cf. R.A.E.*, A **25** 610]. It has almost completely disappeared from Italy, where it was once common and harmful. Possible reasons for this are briefly discussed.

MORRIS (H. M.). **Annual Report of the Entomologist for 1938.**—*Rep. Dep. Agric. Cyprus 1938* repr. 5 pp. Nicosia, 1939. [Recd. 1940.]

In 1938, increased fumigation and spraying were carried out in Cyprus against *Lepidosaphes beckii*, Newm., and *Aonidiella* (*Chrysomphalus*) *aurantii*, Mask., on *Citrus*. *Icerya purchasi*, Mask., was again found on *Citrus* imported from Palestine in 1934 [*cf. R.A.E.*, A **27** 270] and was further recorded in a small area of *Citrus* at Nicosia. Experiments on its control showed that fumigation with hydrocyanic acid gas could be made very effective, without injury to the trees, by increasing the normal dosage, and deciduous trees could be treated in the same way. The youngest eggs of *Icerya* survived fumigation, but the young larvae that hatched from them were controlled by spraying. A consignment of *Rodolia* (*Novius*) *cardinalis*, Muls., was obtained from Egypt, and a few of the Coccinellids liberated, but attempts to breed it on a caged tree were apparently unsuccessful. Hatching of *Dociostaurus maroccanus*, Thnb., and *Calliptamus italicus*, L., was late and irregular. Trials with bait traps containing 1 per cent. ammonium sulphate against *Dacus oleae*, Gmel., on olive [*cf.* **27** 270] were continued during the early months of 1938 in order to complete a year's observations. The traps were examined at intervals of 7 or 10 days, but only small numbers of *Dacus* were caught until the close of the observation period.

Investigations begun in 1937 on the control of the Tineid, *Syringopais temperatella*, Led., on cereals showed that no significant differences in infestation resulted on land that had borne cereals or had been left fallow in the previous season, when it was ploughed with an iron plough soon after harvest, ploughed three times during the summer with a Cyprus wooden plough, or not cultivated until the usual time shortly before sowing. Some evidence was obtained that infestation of cereals is heavier on land that has been left uncultivated during the season prior to sowing. In view of requests for permission to import *Sorghum* sp. for broom-making from countries in which *Pyrausta nubilalis*, Hb., occurs, and the absence of records of this Pyralid from Cyprus, investigations were made to determine whether it occurs there. Many samples of a variety of *Sorghum bicolor* from different areas in Cyprus were examined, and although numerous examples of the Noctuid, *Arenostola pygmina*, Haw., were obtained, none of *P. nubilalis* or of any parasite of it was bred. One adult, however,

was bred from maize, and another was taken at light. It is concluded therefore that it is present in small numbers, but is not at present a serious pest in the Island.

Investigations on the use of a bait-spray against *Ceratitis capitata*, Wied., were carried out in a locality where large quantities of figs were growing near *Citrus* plantations, thus affording favourable conditions for severe attack by *Ceratitis* on *Citrus* fruits in the autumn. A bait-spray of 1 lb. sodium fluosilicate, 30 lb. sugar and 60 gals. water was applied periodically during the summer and autumn, at first to the fig trees and later to both figs and *Citrus*, but catches in bait-traps showed that the effect of spraying was negligible. It is considered that the juice from over-ripe figs on the ground was more attractive than the spray. *Aphelinus mali*, Hald., is now well established in one of the areas in which it was liberated in 1936 against *Eriosoma lanigerum*, Hsm., on apple [*cf.* **27** 271], and during 1938, parasitised material was distributed from this area to a number of other places in which *Eriosoma* occurs. A severe local infestation of vines by *Pseudococcus vitis*, Nied., was reported early in the year. The author suggests that this species may possibly be synonymous with *P. citri*, Risso, which is common on a variety of food-plants but rarely occurs in sufficient numbers to cause serious damage. From a small colony of *P. citri* on *Citrus*, the parasites *Anagyrus pseudococci*, Gir., *Leptomastidea abnormis*, Gir., and *Coccophagus lycimnia*, Wlk., were reared, and their presence may account for its usual unimportance. The Clytrid, *Labidostomis decipiens*, Fald., damaged the twigs and leaves of almond, and also *Schinus molle*, while adults of the Buprestid, *Perotis* (*Aurigena*) *chlorana*, Lap. & Gory, destroyed the shoots of young almond, peach and apple. Greater interest was shown by growers in the control of *Cydia pomonella*, L., on apple and *Recurvaria nanella*, Hb., on peach, while increased spraying was carried out against *Polychrosis botrana*, Schiff., on vines. Galls on the leaves and stems of vines were found to contain Cecidomyiid larvae, some of which were probably *Janetiella* (*Dichelomyia*) *oenephila*, Haimh.

Analyses of the arsenical residues at harvest on apples and grapes that had been sprayed with lead arsenate for the control of insect pests showed that on fruit that had received 4 or more applications, the arsenic residue exceeded the amount tolerated in Great Britain (0·01 grain per lb. fruit). Wiping apples with a damp cloth or dipping apples and grapes into 1 per cent. hydrochloric acid for one minute and subsequently into water and allowing them to dry caused considerable reduction in residues, but did not reduce the heavier deposits to within tolerance. The acid treatment injured some varieties of grapes. It was concluded from these tests that apples and grapes should not be sprayed with arsenicals after 30th June, and that apples should receive not more than 3 and grapes not more than 2 applications before that date, unless special treatment for residue removal is proposed.

A Government Order issued on 13th October 1938 requires treatment or destruction of trees and plants in an area declared to be infested by *Icerya purchasi* and prohibits the removal of trees or plants from such an area. The district at the outskirts of Nicosia [see above] is declared to be infested. A Government Order issued on 26th October 1938 replaces that of 1935 [*cf.* **25** 67] and gives increased powers in controlling the treatment in or movement from the area of *Citrus* trees

and fruit in the area previously declared to be infested by *Lepidosaphes beckii*.

AYOUTANTIS (A.). **Scale Insects observed on *Citrus* in the Island of Crete.**—*Int. Rev. Agric.* **31** no. 1 pp. 2M–4M. Rome, 1940.

The results are given of observations by J. Koronéos on the Coccids that occur in Crete. The species observed on *Citrus* comprised *Chrysomphalus dictyospermi*, Morg., *Aonidiella* (*C.*) *aurantii*, Mask., *Parlatoria zizyphus*, Lucas, and *Saissetia* (*Lecanium*) *oleae*, Bern., which were the most injurious, *Pseudococcus citri*, Risso, *Lepidosaphes beckii*, Newm. (*pinnaeformis*, Bch.), *Coccus* (*Lecanium*) *hesperidum*, L., *Ceroplastes rusci*, L., and *Icerya purchasi*, Mask. *Chrysomphalus dictyospermi* was found only in the Department of Canea and is probably a recent introduction. Infestation by *A. aurantii*, which has been prevalent in Crete for a considerable time, was widespread and harmful except in the Canea district. *Parlatoria zizyphus* was found practically throughout the island. *Pseudococcus citri* occurred in only two localities and was of slight importance, and the other species do little or no damage. *I. purchasi* is widespread, but is controlled by *Rodolia cardinalis*, Muls. The Coccids found on other crops included *Aspidiotus hederae*, Vall., on carob [*Ceratonia siliqua*].

VAN POETEREN (N.). **The Netherlands. Colorado Beetle Situation in 1939.**—*Int. Rev. Agric.* **31** no. 1 pp. 4M–5M. Rome, 1940.

The region in Holland affected by *Leptinotarsa decemlineata*, Say, on potato in 1939 was much the same as in 1938; it lay south of the Rhine, except for one small superficial focus to the north of the river. No large-scale migrations occurred from Belgium or France. The beetle was recorded from 121 communes [*cf. R.A.E.*, A **27** 63; **28** 278], but the majority of the infestations reported comprised only a few adults or a few young larvae. One or several adults were taken on trap-plants round nine of the foci reported in 1938, and the latter were considered to have been completely destroyed. All potato crops in fields and gardens south of the Rhine were sprayed three times with 4 per cent. lead arsenate, and the situation was considered to be more favourable than in 1938.

NOTLEY (F. B.). **Some further Observations on Coffee Thrips.**—*E. Afr. agric. J.* **5** no. 4 pp. 261–267, 3 charts, 3 refs. Nairobi, 1940.

An account is given of observations in 1935–39 in the Northern Province of Tanganyika on *Physothrips xanthocerus*, Hood, on coffee, carried out to determine whether outbreaks of this thrips are correlated with temperature as are those of coffee thrips [*Diarthrothrips coffeae*, Will.] in Kenya [*cf. R.A.E.*, A **24** 284]. During the hot period at the end of 1936 and the beginning of 1937, a severe outbreak of *P. xanthocerus* occurred on coffee over the whole area under observation, causing severe damage. A series of leaf counts begun at the beginning of April, when the outbreak was already in progress, in one badly affected area showed a slight rise in the thrips population to a maximum of 19 per leaf and then a rapid decline. There appeared to be a marked correlation between the average numbers of thrips per leaf and the average maximum day temperatures

of about a fortnight previously. As the breaking of the long rains coincided with the fall in temperature, the decline in population might have been caused by rain, but although a total of 8½ ins. of rain fell between 28th March and 1st April, inclusive, the numbers of thrips actually increased between 1st and 10th April. The population also increased considerably between 17th and 27th April, although by 17th over 29 ins. of rain had fallen in the preceding 28 days. Thrips could still be found in very small numbers in August, when the counts were discontinued.

An outbreak at the Coffee Research Station and local outbreaks elsewhere again occurred in March 1939. Counts had been begun in October 1938, and the course of the outbreak was again correlated with high temperatures, but as only adults were counted there was a time-lag of a month before the figures showed an increase. The period of this outbreak was one of increasing drought, the short rains having failed, but actual drought symptoms, such as wilting of the coffee at mid-day, appeared quite early in the season, considerably before the rise in the numbers of thrips. The rate of increase of the thrips, under these conditions, agreed fairly closely with the theoretical rate of increase of an insect doubling its numbers every seven days. It is concluded from these observations that the thrips increases in numbers when the maximum screen temperatures exceed 27°C. [80·6°F.] and decreases at temperatures below this, although local factors must considerably affect the actual temperature to which it is exposed on coffee. In the Northern Province, local factors that favour the thrips comprise those observed in Kenya [**24** 285] and lack of shade. If maximum temperature is the critical factor, shaded coffee is less likely to suffer from thrips than unshaded. The incidence of the thrips during the four seasons is discussed in relation to temperature. The thrips season is defined as the period from October to April. In 1935–36, the short rains failed, and in December the coffee was very dry. Temperatures in January, February and March were exceptionally low, and there was no thrips outbreak. In 1936–37, temperatures were high over an abnormally long period and the short rains were again very poor. Maximum screen temperatures were almost continuously over 27°C. from the beginning of November to the beginning of April, and a serious outbreak occurred in northern districts. In 1937–38, the short rains were good, temperatures in October, November and December were low, those in January–March were normal for the time of year and no thrips were recorded. In 1938–39, when the short rains were very poor, and the temperature rose rapidly after the end of December, a late thrips attack developed, but although infestation was severe over limited areas, there was no widespread outbreak. The absence of an outbreak in 1937–38, when the maximum temperatures exceeded 27°C. for about the same period as in 1938–39, is attributed to the fact that whereas in the former season the maximum was about 29°C. [84·2°F.], in the latter it was over 30°C. [86°F.] for seven successive weeks. In terms of effective degrees of temperature, 1938 39 was 50 per cent. more favourable to the thrips than 1937–38. The possibility that soil moisture is the determining factor is not, however, excluded, since in 1937–38 soil moisture was high, whereas in 1938–39 it was low. It has also been observed that injury by the thrips is more serious on poor soil that does not retain moisture well, while it is believed locally that irrigation reduces the attack.

It is concluded from these investigations that if maximum temperatures are watched from September onwards, it should be possible to tell by mid-November whether an early outbreak, and therefore probably a serious one, is to be expected. Such a forecast should be modified as the season progresses, and would indicate with fair reliability the probability of an outbreak 3–4 weeks ahead.

DAVIAULT (L.). **Contribution à l'étude des insectes du bouleau.**—*Contr. Inst. Zool. Univ. Montréal* no. 1, 136 pp., 52 figs., 5 graphs., 6 pp. refs. Montreal, 1937. (Repr. from *Nat. canad.* 1935–1937.) [Recd. 1940.]

This work on the insect pests of birch in the Province of Quebec is based on observations by the author over a number of years and on the literature. In all, 88 species in 30 families are dealt with, Lepidoptera being the most numerous of the five Orders represented. Of the species observed, about half of which had not previously been recorded from birch, the most injurious are the sawflies, *Fenusa pusilla*, Lep. (*pumila*, Klug) [*cf. R.A.E.*, A **19** 349] and *Phyllotoma nemorata*, Fall. [*cf.* **27** 275], the Tineid, *Bucculatrix canadensisella*, Chamb. [*cf.* **15** 40] and the Buprestid, *Agrilus anxius*, Gory [*cf.* **17** 232]. The first part (pp. 3–119) comprises a systematic list of the pests, with notes on their morphology, bionomics, distribution and natural enemies and the injury they cause, while the second (pp. 119–123) contains a list of the 28 species that feed only on birch, a brief discussion of the distribution of the various species on the tree, and a table showing the time of year at which they cause damage.

PICKLES (A.). **Report of the Entomologist for the Year 1938.**—*Rep. Dep. Agric. Trin. Tob. 1938* pp. 71–74. Trinidad, 1939. [Recd. 1940].

Breeding and distribution of *Metagonistylum minense*, Tns. [for the control of *Diatraea* (*cf. R.A.E.*, A **27** 24)] were continued in Trinidad in 1938, but although recoveries were made in sugar-cane fields, it is doubtful whether the Tachinid has become established. Following unusually heavy rainfall, infestation of sugar-cane by the first generation of the froghopper [*Tomaspis saccharina*, Dist.] was widespread and relatively severe in northern districts, but owing to the rapid multiplication of entomogenous fungi, the second and third generations were relatively small, and injured canes recovered well. In southern districts, infestation was not severe until the appearance of the third generation, which was rather large. In large-scale experiments on the control of the Cercopid, entire fields were treated with an impregnated pyrethrum dust (0·4 per cent. pyrethrins) mixed with hydrated lime, which was the only carrier readily available in a finely divided state. Distribution was effected by means of a power duster, but was rather uneven, owing to wind. The results showed that the percentages of adult mortality averaged 44 and 64·7 when the amounts of the pyrethrum dust applied per acre were 8·9 and 14·4 lb., respectively. The cost of the work is discussed, and it is considered that control is most easily applied against the first generation, which usually has a limited distribution.

Populations of the cacao thrips [*Selenothrips rubrocinctus*, Giard] increased rapidly in several districts after mid-October, and injury to

cacao was severe by December. The increase was most rapid when conditions were becoming less humid.

The most serious pest of grapefruit in the Colony is still the rust mite [*Phyllocoptruta oleivorus*, Ashm.]. The Trypetids collected in the fruit-fly survey in 1937 [*cf.* **27** 24] were identified as *Anastrepha striata*, Schin., *A. serpentina*, Wied., *A. mombinpraeoptans*, Seín, and *A. distincta*, Greene, which has not previously been recorded from Trinidad. Further collections were made, but no evidence was obtained of the presence of *Ceratitis capitata*, Wied. Moths bred from larvae infesting oranges and grapefruit [*cf.* **25** 17] were identified as *Cydia* (*Laspeyresia*) sp. The general severity of injury by Coccids to *Citrus* at St. Augustine Experiment Station has decreased greatly since 1935, this appears to be due to the establishment of permanent windbreaks of *Gliricidia*, which are now sufficiently well-grown to be effective against *Prontaspis citri*, Comst., *Lepidosaphes beckii*, Newm., and *L. gloveri*, Pack. Minute raised pimples on the surface of bananas that caused large numbers of fruits to be rejected for shipment were found to be due to attempts at oviposition by a species of *Frankliniella*. Numerous fruits were examined, but no injury to the edible portions was observed. Minor pests recorded during the year comprised *Aphis gossypii*, Glov., on water melons and the Trypetid, *Toxotrypana curvicauda*, Gerst., on papaya. Experiments were continued on the storage of fumigated maize under a layer of fine sand [*cf.* **27** 24], and good results were obtained with a container shaped like an inverted cone at the lower end, to which was affixed a trap for withdrawing the grain. The trap is normally rendered insect-proof by inserting it into a box of dry sand.

Insect pests observed during a brief visit to Grenada in November [*cf.* **27** 25] included *Tomaspis saccharina* and *Diatraea* spp. on sugarcane, joint infestation by the latter being about 15 per cent. Infestation of cacao by *Selenothrips rubrocinctus* was severe locally, and although 8,000 thrips were examined, there was no evidence of parasitism by the introduced Eulophid, *Dasyscapus parvipennis*, Gah. [*cf. loc. cit.*]. Other pests of cacao were the Lamiid, *Steirastoma depressum*, L., and *Calotermes* sp., which causes severe injury to living tissues. Damage by this termite is often overlooked until it becomes irreparable. Limes were infested by Coccids and by the weevil, *Diaprepes abbreviatus* var. *comma*, L., which is not numerous and causes little damage.

HAMBLETON (E. J.). **Experiencias para combater o percevejo** *Horcius nobilellus* (**Berg**) **do algodão.** [Experiments in the Control of the Cotton Bug, *H. nobilellus*.]—*Arq. Inst. biol.* **10** pp. 207–217, 2 figs., 4 refs. S. Paulo, 1939. (With a Summary in English.) [Recd. 1940.]

A detailed account is given of field experiments in the summer of 1938–39 on the control of the Capsid, *Horcias nobilellus*, Berg, on cotton in São Paulo, Brazil [*cf. R.A.E.*, A **28** 9]. The dusts used comprised fine sulphur (of which 96 per cent. could pass a 200-mesh sieve), sulphur and Paris green (9 : 1), sulphur, lead arsenate and nicotine sulphate (87 : 10 : 3), calcium arsenate and Paris green (4 : 1), and aluminium arsenate and Paris green (4 : 1). Five applications were made at weekly intervals, beginning on 4th February, and all plots

were also sprayed with lead arsenate for the control of *Alabama argillacea*, Hb. All the dusts gave fair control of both nymphs and adults of the Capsid, the mixture of sulphur and Paris Green, applied at the rate of 16–20 lb. per acre, being the most effective (70 per cent. mortality). Control, however, was poorly related to the yield of cotton. The greatest increase in yield was obtained from plants dusted with sulphur alone, at the rate of about 18 lb. per acre, and slightly smaller increases were obtained from those treated with the sulphur mixtures. The dust containing calcium arsenate was applied at too high a rate and caused considerable scorching of the foliage, while during March, *Aphis gossypii*, Glov., increased rapidly on all plants treated with aluminium or calcium arsenate. The average yields from these plants were lower than those from the controls. Various factors contributed to poor yields throughout the experimental plots, the most important being the shedding of the immature bolls. This was general and coincided with 8 days of dry hot weather following a period of excessive rain. Investigations on the number of applications of sulphur dust and the dates on which they should be made showed that 3–4 applications from the end of January to mid-February are sufficient, as although the Capsid continues to increase after this period, most of the damage is caused before mid-February.

Hambleton (E. J.). **Notas sobre os lepidopteros que atacam os algodoeiros no Brasil.** [Notes on Lepidoptera attacking Cotton in Brazil.]—*Arq. Inst. biol.* **10** pp. 235–248, 9 refs. S. Paulo, 1939. (With a Summary in English.) [Recd. 1940.]

Very brief notes based on the literature and personal observations are given on the bionomics, distribution, food-plants and natural enemies of 37 species of Lepidoptera taken on cotton or in cotton fields in Brazil. Of these, 34 were bred by the author from larvae taken on cotton in the State of São Paulo.

Pemberton (C. E.). **Entomology.**—*Rep. Comm. Exp. Sta. Hawaii Sug. Pl. Ass. 1938–39* pp. 19–27. Honolulu, 1939. [Recd. 1940.]

During the year ending September 1939, the injury caused by insects to sugar-cane in Hawaii was in general less than usual. *Anomala orientalis*, Waterh., was scarce owing to control by the fungus, *Metarrhizium anisopliae*, and the Scoliids, *Campsomeris marginella modesta*, Sm., which was numerous, and *Tiphia segregata*, Crwf. [*cf. R.A.E.*, A **27** 367]. The decline in infestation by *Rhabdocnemis obscura*, Boisd., was due to better control of rats [*cf.* **20** 572], the spread of canes with a hard rind, the elimination of many hold-over crops resulting from quota restrictions, and parasitism by *Ceromasia sphenophori*, Villen.; the examination of a large number of canes in November 1938 showed that 80 per cent. of the larvae of the weevil were attacked by this Tachinid. Parasitism is less in wet, unirrigated areas after the crop is about one year old, as some varieties begin to accumulate dead and dying cane to which the weevils are attracted for oviposition, and trash accumulation protects the larvae from parasitism. Short ratooning of soft canes (such as 28–2055 and POJ 2878) is recommended. In field studies on the longevity and migration of the weevil, 16,000 adults were marked and liberated; living adults were retaken 6 months after liberation at distances of up to 1,200 ft. from the point of release, and both sexes migrated with

equal facility. It is concluded, therefore, that ratoon crops are infested mainly by weevils migrating from adjacent fields [*cf.* **27** 367].

Extensive outbreaks of *Laphygma exempta*, Wlk., occurred in March, April and May 1939 over large areas of young cane on all the islands of the group, but disappeared suddenly at the end of this period. The collapse of the outbreaks was chiefly due to the liberation of large numbers of the Scelionid, *Telenomus nawai*, Ashm. [*cf.* **26** 586] and supplementary control by other parasites. The Scelionid multiplies rapidly, but does not spread quickly through a field [*cf.* **22** 307]. It should therefore be reared in the laboratory and released in numbers over infested areas. Observations in April on one estate on Hawaii showed that the heavy mat of unburned trash in some fields excluded grass in the early growth of the cane to such an extent that the larvae of *Laphygma* failed to develop. Control in fields that had no covering of trash was effected by the destruction of weeds and grass and liberations of *T. nawai*. By August the canes had completely recovered from the infestation. On Kauai, where infestation was severe, control was obtained by means of *T. nawai* and by eliminating Bermuda grass, *Cynodon* (*Capriola*) *dactylon*, from roadsides and ditches. *Perkinsiella saccharicida*, Kirk., was rare, owing to control by its imported natural enemies, particularly *Cyrtorhinus mundulus*, Bredd. Larvae of *Nacoleia* (*Omiodes*) *accepta*, Btlr., which were abundant on several plantations, chiefly infested seedlings of the variety 31–2510; they were controlled by parasites, particularly *Microbracon omiodivorum* Terry [*cf.* **18** 11].

A consignment of the predacious bug [*Cyrtorhinus lividipennis*, Reut.], which feeds on the eggs of the corn leafhopper [*Peregrinus maidis*, Ashm.] in Guam [*cf.* **25** 614], was received in Hawaii during the year, and this Capsid is being bred and liberated against *P. maidis* on maize. The Coccinellid, *Cryptogonus orbiculus* var. *nigripennis*, Weise, which was introduced from Guam a few years ago, has become very abundant on Oahu, where it is exercising effective control of *Pinnaspis buxi*, Bch., on coconut [*cf.* **27** 367]; in one locality this Coccid has almost disappeared from the trees. The establishment of the Agaonid, *Eupristina verticillata*, Wtstn., which pollinates the Chinese banyan, *Ficus retusa* [*cf.* **27** 367], has resulted in the development of viable seed on banyan trees in many parts of Oahu and on Hawaii.

Between 7th October 1938 and 4th August 1939, 66 trans-Pacific aeroplanes were inspected at Midway Island for the presence of insects [*cf.* **27** 368]; those found comprised 1,195 living and 1,272 dead individuals, representing many different species, of which some would undoubtedly be injurious if they became established in Hawaii.

TAKAHASHI (R.). **Two new Diaspine Coccidae from India and the Philippines (Hemiptera).**—*Tenthredo* **2** no. 4 pp. 339–343, 2 figs. Kyoto, Shinomiya, Yamashima, 1939. [Recd. 1940.]

Descriptions are given of the first- and second-instar larvae and the adult female of *Aonidia longispina*, sp. n., which was observed in August 1938 attacking the branches of ber [*Zizyphus jujuba*] in the Punjab, and of the second-instar larva and adult female of *Semelaspidus mangiferae*, sp. n., intercepted in March 1933 in Formosa on the upper surface of the leaves of mango (*Mangifera indica*) imported from the Philippines.

MULLER (H. R. A.). **Overzicht van de belangrijkste citrus-ziekten in Nederlandsch Indië.** [Review of the most important Diseases of *Citrus* in the Netherlands Indies.]—*Meded. alg. Proefst. Landb.* no. 34 (*Meded. Inst. PlZiekt.* 94), 42 pp., 19 pls. Buitenzorg, 1939. (With a Summary in English.) [Recd. 1940.]

This review of the more important fungous diseases of *Citrus* in the Netherlands Indies contains notes on a few that are or may be carried by insects. Bark rot of mandarin orange often begins at places where the adults of *Xylotrupes gideon*, L., have fed upon the bark of the stem and branches. As this Dynastid also feeds on the diseased bark, it possibly contributes to the spread of the rot. *Nematospora coryli* (which causes fruit rot) is carried by bugs, of which the Pentatomid, *Rhynchocoris serratus*, Don., is the commonest. Observations in Sumatra have shown that *Leptoglossus membranaceus*, F., is a vector of it, and in the laboratory at Buitenzorg, *Cappaea taprobanensis*, Dall., also transmitted it. As this Pentatomid generally sucks young shoots, it is probably less important as a vector than the other two. Nymphs of *R. serratus* and *C. taprobanensis* retain the infection for a long period, and even after moulting. Adults of *R. serratus* infected fruit 65 days after the newly hatched nymphs from which they developed had become infected, although they had fed on healthy fruit in the interval. Fruit rot due to *Oospora citri-aurantii* often occurs in fruits injured by the Noctuid, *Othreis fullonia*, Cl. (*Ophideres fullonica*, L.), varieties with thin skins being the most affected.

VAN DER LAAN (P. A.). **Onderzoekingen over de schuurvraat.** [Investigation on Injury to Tobacco Leaves in Drying Sheds by Lepidopterous Larvae.]—*Meded. Deli Proefst.* (3) no. 5, 19 pp., 6 refs. Medan, 1940. (With a Summary in English.)

The value of Deli (Sumatra) tobacco leaf, which is used as wrappers for cigars, is much decreased by attacks by insects, including Lepidopterous larvae that are brought with the leaves into the drying sheds. The most important of these are *Plusia signata*, F., and *Prodenia litura*, F., while *Heliothis assulta*, Gn., is much less injurious. An account is given of experiments carried out in 1939 to ascertain the age at which the larvae cause the most damage and whether injury is caused by those that hatch from eggs brought in on the leaves. For this purpose, eggs and larvae were placed separately on uninfested tobacco leaves that had just been brought into the sheds for drying. Eggs of *P. signata* gave rise to larvae that moved about very little, fed very slightly on the leaves, leaving holes the size of pinpricks over a restricted area, and died in 2–4 days, depending on the rate at which the leaves dried. Larvae that were 1 day old when they were placed on the leaves did very little injury and died after 3 days. Some damage was done by those 3 days old, but the greatest injury was caused by larvae that were 5–7 days old. Individuals that were 9 days old fed little on the leaves and soon pupated.

Larvae of *Prodenia litura* that hatched on the leaves survived for only 1–2 days and caused little injury. Of the larvae placed on the leaves, those 3–11 days old were the most injurious. They were easily seen and could be readily picked off the leaves. Examples that were only 1 day old fed very little and died after about 3 days. The results with *H. assulta* were inconclusive, owing to the great mobility of the

larvae. They feed very little on withering leaves, and the injury they cause is in any case unimportant.

In experiments on the control of the larvae by fumigation, hydrocyanic acid gas, T-gas (90 per cent. ethylene oxide and 10 per cent. carbon dioxide) and methallyl chloride were effective only at concentrations that injured the leaves, and a proprietary sulphur compound, though effective, was too dangerous for ordinary use. It is concluded that the only satisfactory way of controlling infestation is to pick the larvae from the leaves before they are hung up in the sheds.

JANJUA (N. A.). **A Preliminary Note on the Bionomics and Control of the Black Headed Cricket** (*Gryllulus domesticus* **Linn.**) **in Usta Colony** (**Sibi District**) **of Baluchistan.**—*Agric. Live-Stk India* **9** pt. 6 pp. 688–694, 3 figs. Delhi, 1939. [Recd. 1940.]

Gryllulus domesticus, L., all stages of which are described, has caused considerable damage of recent years to crops in the Usta colony, a district in eastern Baluchistan, the climate of which is briefly described, and in 1935–36 completely destroyed autumn crops, particularly cotton, in spite of three or four sowings. Investigations on its bionomics and control were begun in 1935 and continued in 1937 and 1938. Prior to 1930 there was little cultivation in the colony, but since the opening of the Khirtar canal more than two-thirds of the area has been cultivated and the cricket has multiplied rapidly. The main crops are *Sorghum*, *Eruca sativa*, Indian colza (*Brassica campestris*) and wheat, but cotton also is becoming important. The cricket is widely distributed and apparently thrives best in the drier areas, which are very deficient in subsoil moisture. It is also common in the southern part of the adjacent Kachhi province. It has one generation a year, and females oviposit in September in cracks in the soil, dry land being preferred. On an average, a single female lays 120 eggs in 4 or 5 closely packed clusters. The adults die off after oviposition, and the eggs overwinter and hatch at the end of March. Most of the nymphs give rise to adults by the end of June, but pairing and oviposition do not take place until September. In the interim, the adults lie hidden in cracks in the soil.

G. domesticus is omnivorous, feeds on almost every available crop and is nocturnal in habit. The nymphs begin to leave the cracks in search of food about mid-April and first attack *Eruca* and *B. campestris*. They enter the sheaves of the stacked crop and feed on the seeds and stems. From these they migrate to wheat, which is the next crop to be harvested, and then to cotton, which is usually sown from the end of April to the beginning of June. Kernels are removed from freshly sown cotton seeds, and the young germinating plants are cut off at ground level and the cotyledons devoured. Plants a month old are frequently destroyed, but those 8 or 9 inches high often recover from the attack. When food is scarce, any organic matter is accepted; old *Sorghum* stubble is eaten away, and the crickets have even been observed feeding on carcasses. When a swarm reaches a village, the nymphs enter houses and attack food, clothing, and other household articles. Their period of activity extends from mid-April to mid-July, after which they disappear. The adults have not been observed to fly, but they move swiftly and under provocation take long jumps. They can emerge from cracks

and form a swarm within 15 minutes. These swarms vary in size; one observed in May 1937 was 220 yards long and 100 yards wide.

During 1935–36, various poison baits were tested for the control of the pest, the general formula being 10 lb. rice bran, 8 oz. poison, and molasses and water to moisten. Cage tests showed that sodium fluosilicate was the most effective poison for use in baits; it was slightly superior to calcium arsenate and much better than Paris green or lead arsenate. In field tests, sodium fluosilicate was again superior to calcium arsenate, the crickets becoming sluggish two hours after feeding on the former and dying within 12–14 hours, while after feeding on the latter they remained active most of the night and died after 20–22 hours. Fresh baits were preferred. The bait finally evolved, which was used on a large scale, consisted of 20 lb. rice or wheat bran, 1 lb. sodium fluosilicate and 1 lb. molasses, with sufficient water to moisten the mass. Simple and reinforced trenches, commonly used for locust control, were also tested; the crickets crossed the trenches easily, even when they were filled with water, but when a film of kerosene was added they were killed immediately. The adults could swim about 10 ft. in still water, but seldom more than 2 ft. in running water.

The Usta colony is cut off from Kachhi Province along its north and west boundaries by the Khirtar canal, along which, on the Kachhi side, extends a strip of land about ten miles wide comprising a level treeless plain, where the chief crops are *Eruca sativa* and *Brassica campestris*. *G. domesticus* is found there in very large numbers, and there is a constant influx of swarms from Kachhi Province in search of food. When these crops are finished, they attempt to invade the Usta colony by crossing the canal at the bridge points. From mid-April to mid-June in 1937 and 1938, efforts were concentrated on destroying the insects at the six bridges and controlling the pest within the colony. Bridge-ends were blocked by constructing trenches of water covered with kerosene, and by blocking passageways with sheets of galvanised iron, which forced the crickets into the trenches. Only a small proportion entered the colony. In the interior, baits were laid wherever crickets appeared; fresh bait was prepared each afternoon and distributed just after sunset. Where crickets had actually entered sown fields, an acre or so was abandoned to them and the rest immediately flooded, and water channels in and around sown fields were kept filled with water to check migratory swarms. As a result of the campaigns, the area under cotton that was attacked during 1937 and 1938 was only 80 and 50 acres, respectively, out of a total of over 5,000 acres.

Entomology.—*Rep. Dep. Agric. Punjab 1937–38* pp. 44–48. Lahore, 1939. [Recd. 1940.]

A clean-up campaign against spotted bollworms [*Earias*] to destroy their food-supply during the off-season was carried out in the Punjab in March 1938 in a 500 sq. mile area containing about 62,590 acres of cotton fields; for this purpose, all cotton sticks were uprooted entirely or cut, mostly 2 ins. below the ground, to prevent subsequent sprouting, the common weed *Abutilon* was destroyed, and the cultivation of hollyhock and bhindi [*Hibiscus esculentus*], on which the bollworms feed in the off-season, was prevented. In a small part of the cleared

area, in which the cotton sticks were cut 2–3 ins. above the soil surface, sprouting was very common. On the whole, the area became comparatively free from *Earias* and also from the pink bollworm [*Platyedra gossypiella*, Saund.].

Observations on the damage caused to sugar-cane at different stages of growth by the top-borer [*Scirpophaga*] showed that of the shoots attacked by the first generation all died; of those infested by the second 90 per cent. died and there was no cane formation; in the case of the third generation, some 20 per cent. of the shoots died, about 40 per cent. did not grow further, some 25 per cent. were retarded in development, and about 15 per cent. revived; plants infested by the fourth and fifth generations developed normally, but there was loss in tonnage of up to 5 per cent. It was found that infested sugar-cane matures earlier and is richer in sucrose and purity co-efficient, evidently because the growth of the cane stops. From December onwards, however, the attacked canes gradually deteriorated. Early harvesting of the infested cane is therefore recommended; especially as wherever the cane was harvested by the end of January, the infestation was below 1 per cent., as compared with 5–23 per cent. when the cane was crushed late.

Good control of *Pyrilla* spp. on sugar-cane was obtained by hand-netting the adults, repeated 3–4 times by the end of May, and destroying the egg-clusters early in the season.

The second crop of maize and jowar [*Sorghum*] was completely ruined by borers in two areas; they hibernate in the stubble and thorough clean-up of the crops appears to be the only remedy.

The woolly aphis [*Eriosoma lanigerum*, Hsm.] on apples was very effectively controlled by spraying the trees with resin soap and fumigating the soil with paradichlorobenzene.

In experiments on the control of pests of stored grain, a small quantity of mercury placed in a bin safeguarded sound grain from attack; in the case of infested grain, it prevented the increase of the pests, as the mercury vapours killed the eggs.

RAHMAN (K. A.). **Important Insect Pests of the Mango and how to combat them.**—*Punjab Fruit J.* **3** no. 11 repr. 6 pp. Lahore, 1939. [Recd. 1940].

Idiocerus clypealis, Leth., and *I. atkinsoni*, Leth., are present in almost all mango orchards in the Punjab throughout the year, and feed on no other plant. The Jassids hide under the leaves and in cracks in the bark during winter, and on the lower side of the thicker branches and among the leaves during summer, particularly during the hotter part of the day. Many are killed by excessive heat, rain, frost and natural enemies. There are two generations a year [*cf. R.A.E.*, A **12** 385], and oviposition takes place between February and April and between June and August. One female may lay as many as 200 eggs singly in slits in the inflorescences, unopened flowers or young leaves. The nymphs hatch in 8–10 days and mature 17–19 days later. They do serious damage by feeding on the sap of the inflorescence, causing the flowers to drop without setting fruit, and by producing honeydew, on which a black mould develops that interferes with the functioning of the leaves. Thickly planted mango groves should be thinned, and dry branches removed. A spray should be prepared by boiling 6 parts of resin and 1 part of sodium carbonate

with enough water to cover the mixture (adding small quantities of warm water as required), until the liquid becomes thin and clear and deep brown in colour, straining it and diluting the resultant solution with 4–5 parts water. It should be applied in the early morning between mid-December and early February.

Drosicha (*Monophlebus*) *stebbingi* var. *octocaudata*, Green, is a serious pest over the greater part of the Punjab, causing considerable damage to mango, and injuring peach, plum, guava and *Citrus*. The females are found in thick clusters on the terminal shoots and branches between February and April and cause them to wither, so that the flowers set no fruit ; they crawl down the tree or drop to the ground and enter the soil and oviposit in May. The eggs are laid in the soil at a depth of about 4–6 ins., up to 400–500 by each female, and hatch in January. The nymphs feed for a month on low-growing vegetation before ascending trees, and most of them collect in clusters on the tender terminal shoots by about the end of March ; they moult a number of times and mature at the end of April. From late December to late April the trees should bear, 3–4 ft. above the ground, 9-inch bands made of cotton wool or coarse rope soaked in a mixture of equal quantities of coal tar and crude oil emulsion or in resin dissolved in rape-seed oil (3 : 1). When a large number of the mealybugs have collected below the band, they should be sprayed with fish-oil resin soap or brushed into water with a film of kerosene oil on the surface contained either in a vessel or in the irrigation ring round the infested tree. The eggs can be destroyed between July and December by sweeping the rubbish from under the infested trees and burning it and by scraping out the soil to a depth of about 4–6 ins. and using it as litter for cattle, which destroy the eggs by their trampling. The females may be destroyed by spraying heavily infested parts of the plant with a spray of $1\frac{1}{2}$ lb. fish-oil resin soap in 4 gals. water.

Batocera rufomaculata, DeG., is widely distributed in the Punjab and attacks mangos and figs. The adults of this Lamiid are on the wing between May and late August, and the eggs are laid singly in slits in the bark of the branches, the majority during July and August. The larvae hatch in 7–14 days and make zig-zag burrows beneath the bark, with occasional galleries to the surface. When they feed in the heartwood the plant does not usually dry up, but when they tunnel in the sap-wood the plant always dries up and dies. Pupation takes place after about six months, and the adults emerge about four months later and cut their way to the surface. They feed on the bark of young twigs and the petioles. To prevent the spread of this pest, severely attacked trees should be uprooted, wire gauze with a mesh of $\frac{1}{16}$ in. should be wrapped loosely round the stems of the trees during the egg-laying period, and the adults should be collected and destroyed. To kill the larvae, the tunnels should be cleared with a wire from all chewed-up woody fibre and faecal matter, and after the introduction of 1–2 grains of potassium cyanide or a small quantity of kerosene, closed with mud.

The most destructive fruit-fly in the Punjab is *Dacus* (*Chaetodacus*) *zonatus*, Saund., which is widely distributed and attacks mango, peach and guava. The adults are active from June until October ; the females begin to oviposit 18 days after emerging. The eggs are laid singly in the pulp of the fruit just below the skin, their position being marked by a resinous secretion from the fruit. The larvae hatch in 2 3 days, and feed on the pulp of the fruit for 5–16 days, after which

they leave the fruit and pupate in the soil under the tree at a depth of 1–3 ins. The pupal stage lasts 4–16 days in summer and 8–46 days in winter. Infested fruit should be destroyed, and the soil under the plant cultivated at least once a week during June, July and August, whilst to kill the adults, a bait composed of about 2 oz. lead arsenate, 4 oz. molasses and 7 pints of water should be sprayed on to a small patch of the foliage or painted twice weekly on to a board hung horizontally in the tree.

BACK (E. A.). **The Cigarette Beetle as a Pest of Cottonseed Meal.**—*J. econ. Ent.* **32** no. 6 pp. 739–749, 7 figs., 1 ref. Menasha, Wis., 1939. [Recd. 1940.]

When cotton-seed meal is stored for long periods in the southern United States, *Lasioderma serricorne*, F., which is always present in the débris of the warehouse unless remedial measures are taken, often breeds in the outer layers of the stored meal and destroys the sacks. Investigations on its distribution in 100 lb. sacks of meal showed that infestation was confined almost entirely to the outer 2–3 ins. directly beneath the sacking on the exposed surfaces. Portions of the sacks that are closely pressed together in stacking are not affected. In meal stored in bulk, it occurred chiefly within 6 ins. of the surface. The larvae move as close to the sacking as possible to construct their pupal cases, a series of which may be attached to a single fibre. The layer of cocoons is often continuous and $\frac{1}{2}$–$\frac{3}{4}$ in. thick, and it is possible that each cocoon is used by a succession of larvae. The larvae feed on fibres of the sack before pupating to facilitate adult emergence. Though many adults emerge through the interstices of the sack weave, the frequent emergence of those from cocoons built against the fibre itself results in such a weakening of the sacks that they break when the meal is moved. A representative sample of 1 U.S. pint of the meal that had sifted through the sacks, taken from the floor of one warehouse along a tier of sacks, contained 5,974 adults, 519 larvae and 402 pupae of *Lasioderma*. The adults fly readily, particularly towards skylights and open doors; flight is confined largely to late afternoons and dull cloudy days. It is considered that suction light traps might reduce infestation [*cf. R.A.E.*, A **22** 641; **23** 713].

Aplastomorpha calandrae, How., commonly parasitises *L. serricorne* in cotton-seed meal, but though very abundant in 1934, this Pteromalid was not sufficiently active to prevent the larvae of *Lasioderma* from destroying the sacks. Insects found associated with *Lasioderma* comprised *Tribolium confusum*, Duv., in sacked cotton-seed meal and also *Tenebroides mauritanicus*, L., and *Trogoderma tarsale*, Melsh., in meal on the floor. Other pests found in the meal were *Tenebrio molitor*, L., *T. obscurus*, F., *Ephestia cautella*, Wlk., and *Plodia interpunctella*, Hb., but infestation by pests other than *Lasioderma* was usually unimportant.

In one warehouse, *L. serricorne* was controlled by fumigating with hydrocyanic acid gas, using 1 lb. sodium cyanide per 1,000 cu. ft. space for the first application and half as much for the second a fortnight later [*cf.* **24** 294], but in another, a single application at the higher rate killed only the adults on the outside of the sacks. Fumigation should be carried out as early in the season as possible, as the *Lasioderma* population increases rapidly. If it is necessary to control

the infestation before selling the meal and the warehouse is too loosely constructed for fumigation, truck loads can be fumigated in a specially constructed room near the shipping platform, or the meal may be reground just before shipment; this will kill practically all the insects except possibly the eggs. Meal stored in bulk in a compartment with a cement floor and air-tight walls can be fumigated beneath a tarpaulin.

SMITH (R. C.). **Insect Collections and Rearings on Castor Bean Plants, with especial Reference to Grasshoppers.**—*J. econ. Ent.* **32** no. 6 pp. 749–758, 10 figs., 24 refs. Menasha, Wis., 1939. [Recd. 1940.]

In view of statements in the United States that crops can be protected from insect pests by border or strip plantings of castor (*Ricinus communis*), the literature on insects attacking castor and its value as a trap-plant is reviewed, and an account is given of investigations in Kansas in 1938 to ascertain the insects normally associated with castor there and to study the effect of several common varieties of castor on various economic grasshoppers.

The following is based on the author's summary and conclusions: A list is given of about 75 insects taken on *R. communis* in Kansas, and the results are summarised of two series of cage rearings, in the laboratory and in the field, of grasshoppers on castor, on lucerne and on bare soil. It was apparent that castor foliage was not attractive to the grasshoppers, and, when given an opportunity, they fed on various common plants in preference to it. Since grasshoppers died in the test cages containing castor at a rate intermediate between the rate on lucerne and that under starvation conditions, no evidence of poisoning was obtained. While castor is apparently objectionable to grasshoppers, crops cannot be adequately protected by border or strip plantings, because of the easy mobility of the hoppers. It is concluded that no evidence of any value of castor for poisoning, repelling or trapping grasshoppers or any other insect pest of crops was observed during the season of 1938. No real protection was observed in farm plantings and none was reported by farmers.

MCPHAIL (M.). **Protein Lures for Fruitflies.**—*J. econ. Ent.* **32** no. 6 pp. 758–761. Menasha, Wis., 1939. [Recd. 1940.]

An account is given of experiments in Mexico in 1933–34 showing that proteins in the presence of sodium hydroxide solution are very attractive to *Anastrepha striata*, Schin., but not to *A. ludens*, Lw. The following proteins or substances containing proteins were tested individually: casein, gelatin, filter-press mud (a by-product in the manufacture of sugar), baker's yeast, cow hide with the hair attached, cow blood, white of egg and wheat shorts. Each produced an attractive bait, indicating that the phenomenon was true of proteins in general. The concentrations were arbitrarily selected, and preliminary experiments with two of the substances suggested that they could be improved. *A. striata* appears to be typical of a number of fruit-flies in its reaction to ammonia and ammonia compounds, including decomposing proteins. Experiments by workers of the United States Bureau of Entomology, the results of which have not been published, have shown that *Ceratitis capitata*, Wied., and *Dacus cucurbitae*, Coq., in Hawaii and *A. suspensa*, Lw., and *A. mombinpraeoptans*, Seín, in Porto Rico resemble *A. striata* in this respect.

RAWLINS (W. A.). **Planting Dates as affecting Wireworm Injury to Potato Tubers.**—*J. econ. Ent.* **32** no. 6 pp. 761–765, 2 figs., 3 refs. Menasha, Wis., 1939. [Recd. 1940.]

Wireworms cause widespread injury to potato tubers throughout most of the potato-growing areas of western New York. *Agriotes mancus*, Say, and *Pheletes* (*Limonius*) *ectypus*, Say, are the most abundant and injurious and a species of *Melanotus* has caused considerable damage in a few cases. Since the measures recommended against *A. mancus* [*R.A.E.*, A **22** 392; **23** 714] were found to be ineffective against *P. ectypus*, infestation by which starts in cultivated fields, studies on this species, which sometimes causes injury similar to that due to the fungus *Rhizoctonia*, were carried out in 1937–38. Infestations were found almost exclusively in sandy types of soil, whereas *A. mancus* is most abundant in heavy soils. Preliminary observations in 1936 indicated that the larvae migrated downwards some distance from the tubers during the first week in September, and potatoes planted late in the season were found in October to be less severely injured than those planted early, though wireworm infestations were large in both cases.

In the district in which the investigations were made, the planting season extends from the first week in May to the latter part of June, the growing period for potatoes is approximately 90–110 days, and killing frosts usually occur during the last two weeks of October. Potatoes were therefore planted, at intervals of about 2 weeks, from May until early July. Frequent observations were made to determine the time of tuber set, and counts were taken of injured tubers in October, when they were harvested. In 1937, the percentage wireworm injury and the number of punctures per tuber were high in potatoes planted on 19th May and decreased, with one exception, in each successive planting; the experiments in 1938 confirmed these results. Observations at intervals during the growing season in 1938 to determine the advisability of harvesting early to escape wireworm damage late in the season showed that injury increased rapidly from 20th July until 1st September, but only slightly after this date. Wireworm populations in the potato hills increased during August, but decreased sharply after 1st September, and the proportion of injured tubers did not increase significantly after mid-September. Since potatoes planted late set tubers in late August, the crop is not subject to wireworm attack for as long as those planted early, which set tubers in late July and early August. In this district, therefore, potatoes should be planted as late as is economically feasible.

CREIGHTON (J. T.). **Certain Aspects of the White-fringed Beetle Problem.**—*J. econ. Ent.* **32** no. 6 pp. 768–780, 14 figs., 2 refs. Menasha, Wis., 1939. [Recd. 1940.]

The author discusses the influence of food-plants on infestation by *Pantomorus* (*Naupactus*) *leucoloma*, Boh., its probable spread in Florida, and certain aspects of its control, based on observations in 1938 in Florida, Alabama, Mississippi and Louisiana. It appears probable that this weevil will become almost completely polyphagous, but that the degree of infestation, which varies locally, is affected by the type of food material and its availability, as has been shown to be the case with certain other insects [*cf. R.A.E.*, A **27** 258]. In the

district of Florala (Alabama), where the population is greater than in Pensacola (Florida) and New Orleans, though the infestation at New Orleans is much older, ground-nuts and cotton are the determining factor [*cf.* **26** 132], and the reduction or elimination of such favoured food-plants for the control of the weevil should be considered. In 1938, the greatest destruction of crops occurred where ground-nuts or cotton had been grown in 1937. In Alabama, infestation was less heavy in woodland than among field crops, and it is considered that any severe infestation that exists in woodland is due to the annual migration of highly reproductive adults from neighbouring cultivated areas containing favoured food-plants. The presence of large numbers of larvae in the soil was not always accompanied by damage to such crops as ground-nuts, cotton and maize, but severe loss apparently occurs if the numbers increase beyond a certain limit.

The author considers the use of trap-crops inadvisable in areas of low weevil population, such as New Orleans and Pensacola, since in 1938 it was found difficult to maintain a covering of poison dust on them owing to heavy rain, and the consumption of unpoisoned foliage by the adults would increase the biotic potential. Barrier trenches [*cf.* **25** 700] about 10 ins. deep round fields or larger areas were effective against the adults in dry weather, but not after rain, which is often followed in the Florala district by 12–72 hours of cloudy weather, during which the weevils tend to migrate for considerable distances in large numbers. Barriers having an overhang of smooth sheet metal were found to be completely effective, but had to be protected from the weather. Investigations on the effect of disking fallow plots at intervals of 1–6 weeks, carried out between early July and 10th September, indicated that soil populations were reduced by the treatment, but that the weevils were able to deposit viable eggs after feeding on the plot that was disked weekly, though their fecundity and longevity and the percentage of viable eggs deposited may have been reduced. The numbers of eggs deposited increased with the interval between diskings, but this increase was slight with intervals of up to 4 weeks. The emergence of adults was greatest in rainy weather. It is considered impossible to eradicate *P. leucoloma* within 1–2 years by this method.

In the summer of 1938, tests were carried out in Florida on the use of a dust of calcium arsenate against *P. leucoloma* on cotton. Between 10th and 31st July, when rain fell on 16 days and totalled 9·5 ins., the percentage mortality averaged 30·9, but between 1st and 20th August, when a total of 2·06 ins. rain fell on 6 days, the average percentage mortality was 98·2. The efficiency of the dust was reduced considerably by constant rain and slightly by intermittent rain ; very slight rain may increase mortality, as the adults have been observed to drink drops of water containing the arsenical. In attempts to reduce the quantity of available food-plants by killing weeds, an oil emulsion containing sodium arsenite and caustic soda usually gave 98 per cent. initial kill of native weeds and grasses and killed about 35 per cent. of the weevils with which it came in contact. The minimum time for which the emulsion was effective against weeds and grasses averaged 5 days, and mortality of adults kept on the foliage was relatively high for 8 days after it was applied. As it was found that the weevils crawl up the trunks of pecan trees and can lay viable eggs when fed exclusively on pecan foliage, tests on banding pecan trees were begun in July 1938. A band of bark 3½–4 ins. wide and 2–8 ft. above the ground was removed, and a heavy coat of adhesive was applied.

When fresh, this was an effective barrier and also exercised some repellent effect on the adults.

It was observed that in hot dry weather, the weevils remained on the ground or close to it, except when feeding, but they were found on the tops of trees and small buildings when it was wet and cloudy ; they are probably transported on trains or nursery stock at such times. Numbers of adults may be washed about in ditches and covered in 5–6 inches of mud for several days without complete mortality resulting, and many of them are capable of depositing viable eggs when released.

CARTWRIGHT (O. L.). **A Survey of Field Infestations of Insects attacking Corn in the Ear in South Carolina.**—*J. econ. Ent.* **32** no. 6 pp. 780–782, 6 figs. Menasha, Wis., 1939. [Recd. 1940.]

In view of the considerable damage to stored maize in South Carolina by insect pests, infestation by many of which originates in the field, a survey of field maize was carried out in 1938. Between the maturing and harvesting of the maize, 100 ears in each of 2–3 fields in each county, or 10,000 ears in all, were examined ; the results for each county are shown on maps. It was found that throughout the State, 93·82 per cent. of the ears were entered and 84·14 per cent. injured by *Heliothis armigera*, Hb. (*obsoleta*, F.), while 57·71 per cent. were infested by *Cathartus cassiae*, Reiche, 61·05 per cent. by *Pyroderces rileyi*, Wlsm., 31·04 per cent. by *Sitotroga cerealella*, Ol., and 28·02 per cent. by *Calandra* (*Sitophilus*) *oryzae*, L.

THOMPSON (W. L.). **Cultural Practices and their Influence upon *Citrus* Pests.**—*J. econ. Ent.* **32** no. 6 pp. 782–789, 10 refs. Menasha, Wis., 1939. [Recd. 1940.]

A gradual change in spraying and other cultural practices in *Citrus* groves in Florida during the years 1933–38 has produced conditions favourable for the development of Coccids. Copper compounds are used as fungicides and nutritional sprays, and precipitates of zinc and manganese have come into use more recently as nutritional sprays with a resultant increase in Coccid population. Zinc, manganese and copper can all be applied to the soil for nutritional purposes, but quicker and more pronounced results are obtained with less material when they are applied as sprays. In this paper, the deposits left by such materials as hydrated lime and the precipitates of copper, zinc and manganese are referred to as inert residue because they have no insecticidal value. An account is given of experiments on their effect on Coccid populations ; the method of recording the populations is described. A marked increase in the numbers of *Lepidosaphes beckii*, Newm., and *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) observed in 1931 and 1932 after spraying with hydrated lime had indicated that inert residues rather than partial elimination of entomogenous fungi might account for increased populations after spraying with Bordeaux mixture [*cf. R.A.E.*, A **28** 357], and further experiments with copper sprays leaving different amounts of residue confirmed this.

In comparisons made since 1933 of populations of Coccids after the application of sprays of copper and zinc compounds leaving various amounts of inert residues, the populations were, with few exceptions, denser after sprays with heavy than those with light residue [*cf. loc. cit.*]. Entomogenous fungi were not so abundant on plots sprayed with copper as on control plots or plots sprayed with lime-sulphur.

Where two copper sprays were applied within 6–8 weeks, the ratio of fungi to living scales was reduced to a minimum, regardless of the kind or strength of the spray, but the Coccid population increased with the residue. In 1936–38, the addition of wettable sulphur to Bordeaux mixture considerably checked the increase otherwise brought about in the population of *L. beckii*. The ratio of fungi to living scales was much higher on control that on sprayed plots, but the difference in percentage of living scales was not marked. In experiments in 1936 and 1937 to determine the effect on the population of *L. beckii* when zinc sulphate was combined with Bordeaux mixture, the population was greater after applications of Bordeaux mixture, zinc sulphate and hydrated lime (13½ lb. inert residue per 100 U.S. gals.) than after Bordeaux mixture alone (6 lb. per 100 U.S. gals.). Where the zinc sulphate and hydrated lime were applied alone, the Coccid population was not so high as that in the plot that received Bordeaux mixture alone, though the residue was slightly higher, and both were slightly lower than the control. This is one of the few occasions in which an increase in population did not occur as a result of spraying with inert material. When the Bordeaux mixture was supplemented with wettable sulphur or followed by a spray of lime-sulphur and wettable sulphur, the population was lower than when it was not.

Experiments were carried out in 1936–38 to determine the degree of increase of *L. beckii* following application of various zinc compounds combined with either lime-sulphur or wettable sulphur. Three applications were made in 1936, and in 1937 and 1938 only one application was made, followed by two sprays of lime-sulphur and wettable sulphur ; in 1938, an oil spray was applied, in addition, to all plots that had received zinc. By late October 1936, *L. beckii* had increased in all plots where zinc was combined with lime-sulphur, but had apparently decreased in the plots that had received zinc and wettable sulphur. On all plots that had received three zinc sprays, the ratio of fungi to living scales was low. Between October 1936 and February 1937, the population increased by 100–300 per cent. on all plots except the control, and by November 1937, there was a further increase in all plots sprayed with zinc. The ratio of fungi to living Coccids was much higher following one zinc spray than it had been after three. Between November 1937 and February 1938 the Coccid population increased in all plots except the control. By November 1938, there was a more distinct difference between the plots receiving the heavy and light residue sprays. In 1938, the ratio of fungi to living scales was much lower in the plots sprayed with zinc than in the previous year, probably on account of the oil spray applied in June before much of the zinc had been washed off by rain. One year's work indicates that populations of *L. beckii* increase at about the same rate after sprays of manganese sulphate and lime as after sprays of zinc sulphate and lime. They increased more after a spray of Bordeaux mixture, zinc and manganese than after one of Bordeaux mixture and zinc only. It is recommended that materials that leave a heavy residue be applied before growth starts, so that residue remains on old growth only.

It has also been observed that *L. beckii* is more abundant on trees with a higher percentage of green leaves than on those that have a large proportion of bronzed ones owing to magnesium deficiency.

Other pests of *Citrus*, the populations of which increase more rapidly after the application of copper compounds, are *Dialeurodes citrifolii*, Morg., *Pseudococcus citri*, Risso, *Phyllocoptruta* (*Eriophyes*) *oleivorus*,

Ashm., and *Paratetranychus citri*, McG. The addition of wettable sulphur to copper sprays in recent years has helped to offset the added difficulties in insect and mite control.

Bondy (F. F.). **Early versus late Poisoning and a Combination of both for Boll Weevil Control.**—*J. econ. Ent.* **32** no. 6 pp. 789–792, 1 ref. Menasha, Wis., 1939. [Recd. 1940.]

Since dusting with calcium arsenate for the control of *Anthonomus grandis*, Boh., on cotton is followed by injury to sandy types of soil and the occurrence of Aphids in large numbers after several successive applications, efforts were made to overcome these disadvantages by reducing the quantity of the arsenical used. Previous experiments indicated that, under conditions of light damage, satisfactory and economical control could be obtained in South Carolina by using diluted calcium arsenate, and in 1938 the value of diluted calcium arsenate and pre-square treatments (directed against weevils coming out of hibernation) was tested under conditions of moderately heavy damage.

Pre-square applications to the terminal buds of undiluted calcium arsenate dust, equal quantities of calcium arsenate and hydrated lime or mixtures, applied with a mop, of 1 lb. calcium arsenate and 1 gal. water, with or without 1 gal. molasses, made 3 times at intervals of 5 days, resulted in no appreciable increase in yield and were expensive. Pre-square applications of calcium arsenate and hydrated lime or the molasses mixture, followed by 3 of calcium arsenate and hydrated lime when the squares were large enough for oviposition, increased the yields only slightly, with negligible profit and at a high cost. The pre-square molasses treatment followed, after 10 per cent. of the squares were infested, by several applications of calcium arsenate or equal quantities of the arsenate and hydrated lime, sulphur or calcium carbonate increased the yield considerably, with comparatively high profits and low costs. In general, the late dust treatments alone gave the highest yields and profits at the lowest cost.

Undiluted calcium arsenate applied when 10 per cent. of the squares were infested gave the best results throughout, but on light sandy soils, where there is danger of soil injury, the pre-square molasses treatment followed by late dusting with calcium arsenate and hydrated lime, which gave the next best average profit per acre, is recommended. Pre-square treatments delay the date when 10 per cent. of the squares become infested, reduce the number of later dust applications, and hence reduce the danger of soil injury and of building up harmful infestations of Aphids. The best late treatment when there is danger of soil injury and no pre-square treatments have been given is the dust of calcium arsenate and lime, which had the lowest cost per 100 lb. increase of yield. The dust containing sulphur is advisable when the flea hopper [*Psallus seriatus*, Reut.], tarnished plant bug [*Lygus pratensis*, L.] or red spider [*Tetranychus telarius*, L.] is abundant.

McGarr (R. L.). **Progress Report on Mixtures of Calcium Arsenate and Sulfur for Control of the Boll Weevil at State College, Miss.**—*J. econ. Ent.* **32** no. 6 pp. 792–794. Menasha, Wis., 1939. [Recd. 1940.]

Field-plot tests were carried out in Mississippi in 1938 to compare the efficiency of mixtures of calcium arsenate and sulphur (1 : 2 and 1 : 1)

with that of calcium arsenate alone for the control of *Anthonomus grandis*, Boh., on cotton [*cf. R.A.E.*, A **27** 244]. In tests on small plots, 4 effective applications of each dust on cotton planted early in the season were made, the rate of application being 13·7 lb. per acre for the mixtures and 7·1 lb. per acre for calcium arsenate alone. Dusting was begun when about 10 per cent. of the squares were infested, and the applications were repeated at intervals of approximately 5 days when the percentage infestation exceeded 10 for the treatment showing the best control. The percentage infestations after dusting was started averaged 26·9 for the 1 : 2 mixture, 24·8 for the other, 25·5 for calcium arsenate and 40·3 on the control plot, and the average gains in yield of seed cotton were 300, 294, and 266 lb., respectively. The yield from the control plots averaged 1,082 lb. per acre. There was a significant difference between the yield from each poison treatment and that of the control, but none between treatments.

In large-scale tests, calcium arsenate and sulphur (1 : 2) at 13·8 lb. per acre and calcium arsenate at 6·3 lb. per acre were applied to lightly infested cotton planted early in the season, and calcium arsenate and sulphur (1 : 1) at 13·1 lb. per acre and calcium arsenate at 7 lb. per acre to cotton that had been planted at about the middle of the season and that suffered severe damage when untreated. In the first series, the percentage infestation after dusting was begun averaged 14·8 and 13·5, compared with 34·5 in the control, and the average gains in yield were 91 and 145 lb. per acre. In the second series, the percentage infestation averaged 13·7 and 14·4, compared with 45·4 in the control, and the average gains in yield were 666 and 626 lb. per acre. In all tests, the cotton plants were usually more vigorous when the mixtures containing sulphur were used than when calcium arsenate was applied alone.

GAINES (R. C.). **Boll Weevil Control Tests with Calcium Arsenates containing different Percentages of Water-soluble Arsenic Pentoxide.**—*J. econ. Ent.* **32** no. 6 pp. 794–797, 5 refs. Menasha, Wis., 1939. [Recd. 1940.]

As cage experiments had indicated that there was considerable difference in the toxicity to the boll weevil and cotton leaf worm [*Anthonomus grandis*, Boh., and *Alabama argillacea*, Hb.] of calcium arsenates containing different percentages of water-soluble arsenic pentoxide as determined by the New York method [*cf. R.A.E.*, A **27** 246], such calcium arsenates were tested in the field against *Anthonomus grandis* on cotton in localities in South Carolina, Florida, Mississippi, Louisiana and Texas having different soils, climatic and growth conditions and degrees of infestation. The arrangement of the plots, the treatment and the method of taking records are described. Calcium arsenates containing an average of about 0·5, 4·5 and 10·5 per cent. water-soluble arsenic pentoxide were applied at rates of 5·4–6·9 lb. per acre at intervals of five days, and the treatments were begun when about 10 per cent. of the squares were found to be punctured. Analysis of the results showed that there was no significant difference between either infestations or yields after the application of calcium arsenates containing low, intermediate and high percentages of water-soluble arsenic pentoxide. The only significant differences were those between treated and untreated plots.

Smith (G. L.), Scales (A. L.) & Gaines (R. C.). **Additional Records on the Effectiveness of several Insecticides against three Cotton Insects.**—*J. econ. Ent.* **32** no. 6 pp. 798–802, 5 refs. Menasha, Wis., 1939. [Recd. 1940.]

Cage tests in Louisiana in 1938 with 14 commercial calcium arsenates applied as dusts against *Anthonomus grandis*, Boh., or *Alabama argillacea*, Hb., on cotton and tests of the toxicity of some of them to larvae of *Alabama*, carried out by a sandwich method [*cf. R.A.E.*, A **27** 243], confirmed the correlation between the content of water-soluble arsenic pentoxide as determined by the New York method and the net mortality of both species observed in 1937 [**27** 246]. In further cage tests on *Anthonomus* di-calcium arsenate gave a significantly higher mortality than basic calcium arsenate or a commercial calcium arsenate. Mixtures of calcium arsenate and sulphur (1 : 1 and 1 : 2) caused somewhat lower mortality than calcium arsenate alone, but the differences were not significant. Nicotine bentonite, alone or with nicotine tannate, caused significantly lower mortality than any of the other dusts. The addition of wetting agents to the dusts did not significantly affect mortality of *Lygus pratensis*, L., due to derris, sulphur or a mixture of the two, and of the other two insects due to calcium arsenate or cryolite.

Gilmer (P. M.). **Control of the Boll Weevil on Sea-Island Cotton.**—*J. econ. Ent.* **32** no. 6 pp. 802–805, 1 ref. Menasha, Wis., 1939. [Recd. 1940.]

Experiments on the control of *Anthonomus grandis*, Boh., on sea-island cotton [*cf. R.A.E.*, A **27** 247] were continued in 1938 in southern Georgia, where the infestation was the heaviest known for a number of years. Three treatments were tested. On plots on which dusting with calcium arsenate at the rate of 4–7 lb. per acre was begun whenever infestation reached 5 per cent. of the squares in any plot, the yields of seed cotton and of lint averaged 530 and 154 lb. per acre, respectively; 10 effective applications were made. The same dust applied at the same rate when infestation reached 10 per cent. in any plot resulted in average yields of 503 lb. seed cotton and 146 lb. lint, and there were 9 effective applications of dust. A spray of 5 lb. calcium arsenate, 1 U.S. gal. syrup and 49 U.S. gals. water, applied 7 times during the season at a rate of 15–25 U.S. gals. per acre gave an average yield of 454 lb. seed cotton and 131 lb. lint. The yield from the control plot averaged 350 lb. seed cotton (60–75 lb. more than untreated cotton produced commercially in the neighbourhood) and 104 lb. lint per acre. The cost of the treatments and the increase in profit in the treated plots, the value of the lint per lb. and the total value of lint and seed in all the plots are discussed. The increase in value of the crop per acre exceeded the cost of treatment by about $10 in the dusted plots and about $4 in the sprayed plots.

McKinney (K. B.). **Common Insects attacking Sugar Beets and Vegetable Crops in the Salt River Valley of Arizona.**—*J. econ. Ent.* **32** no. 6 pp. 808–810. Menasha, Wis., 1939. [Recd. 1940.]

A list is given of 73 insects commonly found on sugar-beet and vegetable crops in the Salt River Valley, Arizona, between 1932 and

1937, showing the principal plants attacked. This valley, which is geographically isolated and was formerly desert, has been brought to a high state of cultivation by irrigation. Since 1911 there has been a considerable expansion of the area under cultivation, and the market garden industry has become important. The origin of many of the pests is unknown, but examples are given of some believed to be indigenous and others introduced during recent years. It appears that lettuce, sugar-beet grown for seed, cabbage and cauliflower support the greatest variety of insect fauna in this region, followed closely by tomato and bean.

CHIU (Shin Foon). **Toxicity Studies of so-called "inert" Materials with the Rice Weevil and the Granary Weevil.**—*J. econ. Ent.* **32** no. 6 pp. 810–821, 14 figs., 11 refs. Menasha, Wis., 1939. [Recd. 1940.]

The following is based on the author's summary of tests of the action of six so-called "inert" dusts on adults of *Calandra* (*Sitophilus*) *oryzae*, L., and *C.* (*S.*) *granaria*, L., the materials tested and the methods of experiment and of interpretation of results being essentially the same as those previously used for *Bruchus* (*Acanthoscelides*) *obtectus*, Say [*R.A.E.*, A **27** 531]: Crystalline silica was most effective in killing the weevils, and magnesium carbonate, amorphous silica, bentonite, talc and walnut-shell flour were decreasingly effective in the order given. Within a certain range, there is a definite correlation between effectiveness and particle size of the crystalline silica dust, higher insecticidal efficiency being obtained with finer particles. The relative humidity of the environment is an important factor influencing the toxicity of the crystalline silica dust. The killing effect is much quicker at low relative humidities than at high ones. It was found that insects dusted with effective "inert" materials lost weight very rapidly, and this is assumed to be mainly due to the loss of water from the body. Based on observations of the loss of weight of dusted insects, the difference in insecticidal efficiency of the "inert" material when used against insects provided with food and without food and the effectiveness of the "inert" material when the atmosphere is saturated, it is believed that the insects are killed through desiccation and through mechanical irritation.

GAINES (J. C.). **Insecticide Tests for Bollworm Control during 1938.**—*J. econ. Ent.* **32** no. 6 pp. 821–824, 8 refs. Menasha, Wis., 1939. [Recd. 1940.]

Further tests on the control of *Heliothis armigera*, Hb. (*obsoleta*, F.) on cotton [*cf. R.A.E.*, A **27** 417] were carried out in Texas in 1938 to determine the comparative effectiveness of arsenical dusts containing different amounts of total and water-soluble As_2O_5 and As_2O_3, and calcium arsenates containing varying amounts of water-soluble As_2O_5. In one experiment, calcium arsenate, Paris green and three other arsenicals were compared in a Latin square arrangement of plots, and in the other, three calcium arsenates were compared in a randomised block. All applications of dust were made early in the morning when the cotton was wet with dew, and each dust was applied effectively

four times between 9th July and 2nd August. An application of calcium arsenate for the control of leaf worms [*Alabama argillacea*, Hb.] was made on all plots on 8th August. The analyses of variance for injury and yields in each series showed that there were significant differences between the insecticide treatments and the controls, but none between the different treatments, all the insecticides being equally effective in controlling *H. armigera*.

LAMERSON (P. G.) & PARKER (R. L.). **Control of the American Strawberry Leaf Roller, *Ancylis fragariae*, in the lower Missouri River Valley.**—*J. econ. Ent.* **32** no. 6 pp. 824–828. Menasha, Wis, 1939. [Recd. 1940.]

An account is given of investigations on the seasonal development and control of *Ancylis comptana*, Froel. (*fragariae*, Walsh & Riley) on strawberry carried out in 1938 in districts on the lower Missouri in Nebraska and Kansas. Various insecticides were tested against the larvae of each of the three complete generations. Mixtures of ½ pint free nicotine (50 per cent.) or nicotine sulphate (40 per cent.) with 1 quart summer oil emulsion, applied 3 times at intervals of 5 days between the first hatching of the larvae and the first leaf-rolling, afforded the best control of all three generations, giving average mortalities of 96·2 and about 93 per cent. Sprays of 1½ lb. lead arsenate or 2 lb. cryolite combined with 1 U.S. quart neutral soluble fish oil, which were tested against the second and third generations only, were rather less effective. A strong pyrethrum dust (0·8 per cent. pyrethrins) appeared to be the most effective treatment against all generations after the leaves were rolled, giving an average of 96·8 per cent. mortality.

LAMERSON (P. G.) & PARKER (R. L.). **Lead Arsenate Combinations and Nicotine Combinations as Control Measures for the Codling Moth, 1938.**—*J. econ. Ent.* **32** no. 6 pp. 828–832, 8 refs. Menasha, Wis., 1939. [Recd. 1940.]

Further experiments on the control of the codling moth [*Cydia pomonella*, L.] were carried out in north-eastern Kansas in 1938 [*cf. R.A.E.*, A **27** 166, etc.] on apple trees that had received a calyx spray of 4 lb. lead arsenate per 100 U.S. gals. Some trees were given 7 cover sprays of non-astringent lead arsenate, applied alone, with proprietary oils in the third, fourth and fifth sprays, or with soy-bean flour in all of them, and others 8 cover sprays of nicotine sulphate and oil or fixed nicotine. The 5 most effective sprays contained 4 lb. lead arsenate per 100 U.S. gals. with 1 U.S. quart oil or with soy-bean flour; 1 lb. refined soy-bean flour gave the best result, and 4 lb. crude soy-bean flour was less effective than one of the three oils. The nicotine sprays were less effective than one containing 3 lb. lead arsenate and 2 U.S. quarts oil, but were more effective than lead arsenate alone. The only serious damage to foliage occurred on trees to which lead arsenate and soy-bean flour were applied. The refined flour caused heavy damage and about 50 per cent. defoliation, and the damage resulting from the use of crude flour was greater. The fruit from these trees did not ripen before harvest. The apples from all lead arsenate

plots were below the arsenic tolerance of 0·01 grain per lb. after being washed. Samples of apples from the nicotine plots did not show the presence of nicotine at the time of harvest.

HOOD (C. E.). **Spray Experiments for the Control of the Elm Leaf Beetle.**—*J. econ. Ent.* **32** no. 6 pp. 833–838, 3 figs. Menasha, Wis., 1939. [Recd. 1940.]

Galerucella luteola, Müll. (*xanthomelaena*, Schr.) is one of the most serious insect enemies of the American elm (*Ulmus americana*) in the United States. It is usually controlled by one or more applications of 4–8 lb. powdered acid lead arsenate per 100 U.S. gals. water per season. Experiments were carried out in 1931, 1932 and 1934 in New Hampshire to determine the minimum dosage of lead arsenate necessary for control, the most favourable time of application, and the possibility of successful control with only one treatment. In 1931 and 1932, spraying was begun on 19th June, when there were a few adults and many eggs and larvae on the trees. In 1934, some trees were sprayed on 28th May, when only a few adults and eggs were observed, and others on 22nd June, when larvae were present as well as adults and eggs. In each year, a moderate amount of both adult and larval feeding had occurred on the trees sprayed in June. Unsprayed trees were heavily defoliated.

Good control was maintained in 1931 with a spray of 4 lb. lead arsenate, 1 U.S. pint fish oil and 100 U.S. gals. water, and in 1932 with one of 3 lb. lead arsenate with fish oil. In 1932, 4 lb. lead arsenate without fish oil gave almost the same degree of control as 3 lb. with it ; 2 lb. with fish oil gave fairly good results on some of the trees, but when rain fell before or shortly after the treatment was completed control was not so good. In 1934, when fish oil was used in all sprays, the best control was obtained on the trees treated on 28th May ; the spray contained 4 lb. lead arsenate, but the increased control was due to a considerable extent to the earliness of the spray. On the trees treated on 22nd June, sprays containing 3 and 4 lb. lead arsenate were about equally efficient, giving results rated as fair to good.

It is concluded that a spray of 3 lb. lead arsenate, 1 U.S. pint fish oil and 100 U.S. gals. water should be applied between the date when the last beetles emerge from hibernation (about 25th May) and 10th June in the New England States [*cf. R.A.E.*, A **26** 18]. The application can be extended beyond this date if necessary to complete the spray schedule. The early application reduces the adult population to a minimum before many eggs have been laid. It also protects the tree for the entire season against adults emerging from hibernation and those migrating from untreated trees, as well as against larvae and the new generation of adults, which are abundant in August and which feed to a considerable extent before hibernation. The under surface of the foliage should be treated as thoroughly as possible, as the larvae feed almost exclusively on it. Linseed oil can be substituted for fish oil, but if neither is used, an additional 1 lb. lead arsenate per 100 U.S. gals. water is necessary to allow for loss due to rains that may occur shortly after application. If the spray equipment is not powerful enough to reach the upper part of tall trees, as much of the tree as possible should be sprayed, as the loss in vitality is reduced and the recovery of the defoliated portion is hastened.

MARSHALL (James). **The Hydrogen Ion Concentration of the Digestive Fluids and Blood of the Codling Moth Larva.**—*J. econ. Ent.* **32** no. 6 pp. 838–843, 1 fig., 11 refs. Menasha, Wis., 1939. [Recd. 1940.]

The results are given of a study of the hydrogen-ion concentration of the digestive fluids and blood of larvae of *Cydia* (*Carpocapsa*) *pomonella*, L. Colorimetric determinations of the crop and ventriculus of first-instar larvae agreed reasonably well with those of third- to fifth-instar larvae, though they were somewhat more variable. They indicated the hydrogen-ion concentration of these portions to be in the neighbourhood of pH 8·5 in the first instar, and perhaps slightly higher in the later instars. Potentiometric determinations for third- to fifth-instar larvae indicated an average pH of 8·7, and from this it is assumed that the actual pH for larvae in the first instar may likewise reach 8·7. The alimentary fluids of the larvae are evidently well buffered, though the nature of the buffer or buffers was not investigated. Ingestion of the acid pulp of an unripe apple did not appreciably reduce the active alkalinity of these fluids. The hydrogen-ion concentration of the blood of the fourth-instar larva was found to be between pH 6·7 and pH 6·8. These characteristics of the internal environment of the larvae may have a practical bearing on their control by alimentary poisons. It has been found that a commercial calcium arsenate is about 40 times as readily soluble in the juice of unripe Jonathan apples as acid lead arsenate, but though the larvae apparently consume a considerable amount of apple juice or tissues soon after entering the fruit, the calcium arsenate is not distinctly the more toxic when the particle sizes are equal, probably because the acidity of the fruit juice is of little importance in well-buffered alkaline digestive secretions. It is possible that in such conditions acid lead arsenate is actually more soluble than calcium arsenate.

HOCKENYOS (G. L.). **Factors Influencing the Absorption of Sodium Fluoride by the American Cockroach.**—*J. econ. Ent.* **32** no. 6 pp. 843–848, 4 refs. Menasha, Wis., 1939. [Recd. 1940.]

The following is the author's summary: The body integument of *Periplaneta americana*, L., is found to have the properties of a semi-permeable membrane coated with a film of water-resisting fat or oil. The rate of absorption of sodium fluoride is influenced by the osmotic force exerted by the body fluid and by various factors that act upon the oil film. These factors are temperature and chemicals that either absorb or react with the film.

HOFFMANN (C. H.). **Observations on the Biology of *Saperda tridentata* Oliv. and *Magdalis armicollis* Say (Coleoptera).**—*J. econ. Ent.* **32** no. 6 pp. 848–851, 2 refs. Menasha, Wis., 1939. [Recd. 1940.]

The results are given of a study of the biology of *Eutetrapha* (*Saperda*) *tridentata*, Ol., and *Magdalis armicollis*, Say, made in 1935–37 to determine whether their habits were such that they might be vectors of *Ophiostoma* (*Ceratostomella*) *ulmi*, the fungus that causes Dutch elm disease. The larvae of *E. tridentata* tunnel in the inner bark and sapwood of elm and, if abundant, girdle the branches and the trunk, causing the death of the tree. It is thought that this species

usually attacks devitalised wood, but individuals have been observed in apparently healthy tissue. Adults emerge in New Jersey from about mid-May until August. During the flight period, they occasionally fed on elm leaves. Caged individuals fed on leaves and on the bark of young elm twigs, but seldom penetrated to the xylem. Eggs are laid in the inner bark, 1–3 at a time, and the incision is partly closed with finely shredded bark fibres. The individual females oviposit for a week or more. The larvae score both the inner bark and the outer wood and pupate in cells in the bark or sapwood. The average durations of the prepupal and pupal periods for 16 individuals during May were about 5 and 20 days. In logs in which oviposition took place in June and July 1935, some individuals completed the life-cycle in one year while others required two. Two larvae were alive when the bark was removed from all the logs in October 1937. The abundance of *E. tridentata* and associated beetles can be materially reduced by the removal and burning of infested elm material in autumn or winter or before the adults emerge in the spring.

The larvae of *M. armicollis* often occur in immense numbers under the bark of dying or recently dead elms and occasionally extend their galleries into the adjacent living tissue. In New Jersey, small suppressed trees with one or more dead branches in the crown appear especially vulnerable. Galleries with small larvae were observed in the trunk of one apparently healthy, though suppressed tree. Adults emerge through small holes in the bark throughout the summer and some feed on elm leaves, usually skeletonising them. The eggs are deposited, singly or in groups, in punctures that usually terminate deep in the inner bark, and the cavity is then sealed with borings and a secretion. The larval tunnels usually radiate from a group of oviposition punctures, run parallel with the grain of the wood and score both the inner bark and the wood. The prepupal and pupal stages required about 2 and 9 days, respectively. In experiments similar to those made with *E. tridentata*, the life-cycle was invariably completed in about one year. Control measures are the same as for *E. tridentata*.

Shepard (H. H.) & Buzicky (A. W.). **Further Studies of Methyl Bromide as an Insect Fumigant.**—*J. econ. Ent.* **32** no. 6 pp. 854–859, 2 figs., 10 refs. Menasha, Wis., 1939. [Recd. 1940.]

Laboratory tests of methyl bromide as a fumigant were continued in 1938 with further common insects that occur in houses or infest stored products [*cf. R.A.E.*, A **26** 389]. Their susceptibility to methyl bromide and its effectiveness in comparison with that of other fumigants are shown in a table. With 5 hours' exposure at 25°C. [77°F.], the median lethal concentration in mg. per litre of methyl bromide, chloropicrin, ethylene oxide, carbon bisulphide and ethylene dichloride to the larvae of *Attagenus piceus*, Ol., and of the first two to the adults, were 17·5, 5, 17, 88, 195, 9·5 and 1·3, respectively, and those of methyl bromide were 5 and 3·1 to larvae and adults of *Plodia interpunctella*, Hb., 13 and 7 to larvae of *Tenebrio obscurus*, F., and *Tineola biselliella*, Humm., 4·2 and 4·7 to male and female adults of *Spermophagus* (*Zabrotes*) *subfasciatus*, Boh., and 6·5 and 5·4 to adults of *Sitodrepa* (*Stegobium*) *panicea*, L., and *Rhizopertha dominica*, F. The insect material used was as nearly uniform as possible, most of the larvae being almost full-grown and most of the adults fairly young.

Differences in the speed of action of various fumigants against adults of *Tribolium confusum*, Duv., are shown on graphs. Hydrocyanic acid gas exhibited no delayed action, all the beetles killed being dead and the others active at the end of the exposure period. Those exposed to carbon bisulphide were anaesthetised, and many exhibited partial recovery before they succumbed. Those exposed to methyl bromide at higher concentrations than that necessary for complete mortality seemed normally active immediately after exposure but died within 48 hours. The data relative to the influence of low temperature on the toxicity of methyl bromide were completed. An added lethal effect of the low temperature appeared to depend on the cold resistance of the particular species concerned. The dose required to kill adult *Tribolium* increased down to about 8–9°C. (about 45–48°F.), and then decreased, whereas that necessary to kill adults of *Calandra* (*Sitophilus*) *granaria*, L., increased down to nearly 0°C. [32°F.]. The temperature appeared to have no effect on the flour absorption ratio.

Baking tests with flour fumigated for 5 hours with methyl bromide at 2 lb. per 1,000 cu. ft. showed no detectable injury.

Barnes (D. F.), Fisher (C. K.) & Kaloostian (G. H.). **Flight Habits of the Raisin Moth and other Insects as indicated by the Use of a Rotary Net.**—*J. econ. Ent.* **32** no. 6 pp. 859–863, 1 fig., 2 refs. Menasha, Wis., 1939. [Recd. 1940.]

The following is based almost entirely on the authors' summary: A motor-driven rotating net, a description of which is given, was kept in operation almost continuously from 16th June to 13th November 1937 in a fig orchard near Fresno, California. Between 12th July and 6th November, 12,600 adults of the raisin moth, *Ephestia figulilella*, Gregson [*cf. R.A.E.*, A **23** 19] were caught in it. Their comparative abundance from day to day was shown by daily collections from the net bag, and data were obtained on the percentages of gravid females. Their flight habits and those of *Cnemeplatia sericea*, Horn (a Tenebrionid included in the observation because it had been found feeding on fallen figs and because its activity was delicately controlled by light intensity) were studied in detail by making collections at intervals of 15 minutes on 6 nights. *E. figulilella* began to fly about 35 minutes after sunset; females were most active early in the evening. Flight was controlled by light intensity. *C. sericea* exhibited a restricted flight period of about 45 minutes just before darkness set in. Only 1,386 dried fruit beetles (*Carpophilus hemipterus*, L.) were taken in 136 trap-days. August was the month of their greatest abundance, and they did not fly at night. Counts were also made of Staphylinid beetles and honey-bees taken in the collections. Since the rotary net is non-selective, it offers a useful means for obtaining information about the aerial activity of both sexes of flying insects at any time of day or night.

Ellisor (L. O.) & Floyd (E. H.). **Further Investigations on the Control of the Velvetbean Caterpillar, *Anticarsia gemmatilis* (Hbn.).**—*J. econ. Ent.* **32** no. 6 pp. 863–867. Menasha, Wis., 1939. [Recd. 1940.]

In 1938, as in previous years, *Anticarsia gemmatalis*, Hb., became a serious pest of soy beans in Louisiana in the autumn. The larvae

were first observed on 15th July, but they did not appear in destructive numbers until mid-August, and it was not until the third generation appeared in mid-September that extensive defoliation of soy beans resulted. An unusual feature of the outbreak was that the larvae appeared simultaneously in destructive numbers at localised points throughout the State ; the species usually spreads from south to north as the season advances.

In the late summer and autumn, further experiments against the larvae were carried out in the laboratory and in the field with various proprietary dust insecticides [*cf. R.A.E.*, A **27** 258]. The laboratory tests were made by feeding the larvae on leaves on which the dust had been allowed to settle in a cylinder, and the rate of application was one at which the most toxic dust did not give 100 per cent. mortality, so that the toxicities of the dusts could be compared. In the case of the more effective dusts, the percentage mortalities in 3 days were 90 with basic copper arsenate, 64 with basic lead arsenate, 83 with Syncryolite (an imported synthetic cryolite stated to be 98–100 per cent. pure), 73 with Alorco cryolite (a neutral synthetic cryolite containing 87·1 per cent. sodium fluoaluminate), and 65 with Dutox (which was stated to contain 72 per cent. barium fluosilicate and 8 per cent. sodium fluoaluminate). All these except basic lead arsenate, which was not tested as it is injurious to soy-bean foliage, gave good control without damaging the foliage in the field, when applied at rates between 6·8 and 10 lb. per acre. Basic copper arsenate retained its toxicity for several weeks after application [*cf.* **27** 422]. In two of the tests, a single application was made in September, but in the other two, heavy infestation occurred in August and two treatments were given, one in August and the other in September. Dusting cryolite (an experimental material of good dusting properties containing 31·7 per cent. sodium fluoaluminate), a dual fixed nicotine (a non-volatile mixture of nicotine tannate and nicotine bentonite containing 3·75 per cent. nicotine), a derris dust (1 per cent. rotenone) and magnesium arsenate were also tested in the laboratory, but showed little or no toxicity.

Hamilton (D. W.) & Steiner (L. F.). **Light Traps and Codling Moth Control.**—*J. econ. Ent.* **32** no. 6 pp. 867–872, 2 figs., 6 refs. Menasha, Wis, 1939. [Recd. 1940.]

The following is based on the authors' summary : A field experiment for studying the value of light-traps as a measure for the control of *Cydia* (*Carpocapsa*) *pomonella*, L., on apple and for determining the relative efficiency of the light sources available for such traps was begun in 1934. The presence of bait-trap areas in the same orchards made comparisons between the effectiveness of bait-traps and of light-traps also possible. These investigations were conducted on a relatively large scale at Orleans, Indiana, during 1934 and 1935, and continued on a small scale at Poughkeepsie, New York, during 1936.

Comparative tests of the relative attractiveness of different types of lamps indicated that the mercury vapour tube and the G-1 mercury vapour lamp are about equally attractive to *C. pomonella* and definitely superior to Mazda lamps of 200 watts or less. The lamps used were not powerful enough to attract moths much further than 35 ft. Traps hung over open spaces averaged only 5 moths each as compared with 127 per trap for those in adjacent trees. In 1934 at Orleans, the infestation in the area of $5\frac{1}{4}$ acres containing one light-trap at the

top of each tree and one over each of 15 vacant spaces in the outer rows was reduced to 44 per cent. below that in the surrounding control blocks. The area was normally one of the most seriously injured in the orchard. In 1935, seasonal conditions were extremely unfavourable for *C. pomonella*, and the lighted area showed a reduction of 90 per cent. in infestation. Because they artificially stimulate activity during hours when the natural light is too weak for normal activity, light-traps are good indicators of moth abundance, but are less informative than bait-traps as to normal flight activity. Light-traps caught more moths per trap than neighbouring bait-traps, but the percentage of females was much smaller. Releases of marked moths indicated that moths left the light-trap area as well as entered it, and some apparently remained within the area as long as 11 days before capture. Most of the moths were caught on the first or second night after their release.

GOODHUE (L. D.) & HALLER (H. L.). **Analysis of the Water Extract of Derris and Cubé.**—*J. econ. Ent.* **32** no. 6 pp. 877–879, 5 refs. Menasha, Wis., 1939. [Recd. 1940.]

The following is the authors' summary: The water extracts of seven samples of derris, cubé and timbo have been examined chemically. From 24 to 41 per cent. of the active material can be removed by one extraction, and successive extractions remove more. When preserved against fermentation, these suspensions of the active principle are very stable. Both glucose and levulose were found to be present in one sample. The glucosides similar to saponin had no haemolytic power.

BARBER (G. W.). **Injury to Sweet Corn by *Euxesta stigmatias* Loew in southern Florida.**—*J. econ. Ent.* **32** no. 6 pp. 879–880, 2 figs., 1 ref. Menasha, Wis., 1939. [Recd. 1940.]

Euxesta stigmatias, Lw. [*cf. R.A.E.*, A **27** 328] was first observed by the author in south-eastern Florida in February and March 1936. At that time and during a similar period in 1937 and 1938, the larvae were found feeding in the internal silks of occasional ears of two varieties of sweet field maize. In each year, they increased in abundance as the season advanced and were most plentiful late in March, but they never caused injury to the ears beyond rotting of the silks or of the tips of the cobs. In 1939, this Ortalid appeared in sweet maize in one of the most south-easterly maize fields in the State at the beginning of March, and by the middle of the month about half the ears then being harvested in the roasting-ear stage were infested. The larvae had penetrated to kernels on all parts of many of the ears and caused them to become shrunken and brown. Only an occasional ear was infested on sweet maize, 5 miles away. The difference in the type of injury to field maize and sweet maize seemed to be correlated with differences in the character of the husk. The husks of the two varieties of sweet field maize are very tight, whereas those of sweet maize are much looser. There were often 10–20 larvae per ear, but usually less. The extreme south-easterly position of the severe infestation suggests that the adults had been carried from the West Indies by wind, which usually blows from the east or south-east during February and March.

BOHART (R. M.). **A new Host Plant and Locality Record for the Christmas Berry Thrips.**—*J. econ. Ent.* **32** no. 6 pp. 880–881, 1 fig., 1 ref. Menasha, Wis., 1939. [Recd. 1940.]

Rhynchothrips ilex, Moult., the previously known distribution of which practically coincided with that of *Photinia arbutifolia*, the only plant on which it was known to breed [*R.A.E.*, A **25** 241], was found in June 1939 heavily infesting *Rhus ovata* on the hot, dry eastern slopes of a mountain in southern California outside the area from which it had previously been recorded. The damage to *R. ovata* is similar to that to *P. arbutifolia*, but the leaves become more curled, and the distortion changes the entire appearance of the plant. The larvae feed within cavities that they have made on the upper surfaces of the leaves, and the adults oviposit in the same cavities. Under experimental conditions, which are described, second-instar larvae were reared to the adult stage on both food-plants. The prepupal stage lasted 2–3 days and the pupal stage less than a week. Adults continued to feed in their artificial environment for several weeks until the experiment was discontinued.

POOS (F. W.). **Host Plants harboring *Aplanobacter stewarti* without showing external Symptoms after Inoculation by *Chaetocnema pulicaria*.**—*J. econ. Ent.* **32** no. 6 pp. 881–882. Menasha, Wis., 1939. [Recd. 1940.]

As adults of *Chaetocnema pulicaria*, Melsh., infected with *Aplanobacter stewarti*, the causal organism of bacterial wilt of maize, had often been found in collections made where it was unlikely that they could have fed on infected maize, especially maize showing external symptoms of the disease, or that they could have migrated from infected areas in sufficient numbers to account for the high proportion found, experiments were carried out in Virginia during 1938 and 1939 to determine how such beetles become infected. Adults that had been kept in cages on infected maize for several days were confined for about as long on various graminaceous plants and then removed. No symptoms of bacterial wilt having developed 3–6 weeks later, parts of the plants with no feeding marks or visible extraneous matter upon them were macerated, and the juice expressed was used to inoculate susceptible sweet maize in the greenhouse. Distilled water and juice from healthy maize, wheat or grasses to which the beetles had not had access were inoculated into other plants as controls, but produced no symptoms. Typical symptoms were produced by inoculations with juice from maize, wheat and various grasses on which *C. pulicaria* had fed. In 14 out of 46 tests with juice from the species other than maize, typical symptoms were obtained in 25 out of 123 inoculated maize plants. Inoculations with juice from a very susceptible variety of sweet maize, a resistant variety of sweet maize and field maize, all of which had been fed upon but had not developed symptoms, produced typical symptoms in 9 out of 9, 6 out of 11 and 3 out of 10 inoculated plants, respectively. The presence of the wilt organism in the juice of *Poa pratensis*, *Dactylis glomerata* and wheat suggested that it might not overwinter in the beetles, but that these might become infected on leaving hibernation by feeding on plants that harboured wilt without showing symptoms. However, evidence that the organism overwinters in the beetle was obtained by producing typical symptoms in susceptible sweet maize

plants by means of inoculum made from adults taken from emergence cages in the field in which the vegetation had died before the beetles emerged. It seems probable that plants that harbour wilt without showing symptoms occur in the field and that they may have an important relation to the abundance of wilt in maize.

SAKIMURA (K.). *Thrips nigropilosus* **Uzel, a Non-vector of the Yellow Spot Virus.**—*J. econ. Ent.* **32** no. 6 p. 883, 3 refs. Menasha, Wis., 1939. [Recd. 1940.]

In experiments carried out in Hawaii, none of 668 adults of *Thrips nigropilosus*, Uzel, transmitted the yellow spot virus when transferred from infected plants of *Emilia sonchifolia* (the principal weed host of the virus), potato, egg-plant [*Solanum melongena*] and *Datura stramonium* to uninfected plants of these and several other susceptible species, including pineapple, whereas *T. tabaci*, Lind., the only known vector in Hawaii, freely became infective after feeding on the same or similar source plants. In preliminary tests with *Hercinothrips femoralis*, Reut., none of 250 adults transferred from infected *Emilia* and celery transmitted the virus.

DOWNES (W.). **Derris for Ants and Wasps.**—*J. econ. Ent.* **32** no. 6 pp. 883–884. Menasha, Wis., 1939. [Recd. 1940.]

An account is given of the eradication, in one week, of a large colony of carpenter ants (*Camponotus*) in a dwelling house near Victoria, British Columbia, by means of derris powder (4 per cent. rotenone). During the years 1938 and 1939, derris was recommended and used against carpenter ants in a number of other cases with complete success in each instance. When infestation was light, the ants usually disappeared in 2–3 days. Any colony can be eradicated if the derris can be placed where the ants have to come in contact with it. A handful of derris powder thrown on the emergence hole of a wasps' nest usually exterminated the colony within 24 hours, and small nests were destroyed in 5 hours. Hornets seem rather more resistant than wasps, but a hornets' nest in a cherry tree was destroyed in 24 hours by throwing a handful of derris powder at the hole in the side. In 1938, a colony of honey-bees that had established itself under the shingles above the bow-window of a house 2 years previously was controlled by stopping all entrances except one, into which liberal quantities of derris powder were thrown.

SWINGLE (M. C.). **The Effect of previous Diet on the Toxic Action of Lead Arsenate to a Leaf-feeding Insect.**—*J. econ. Ent.* **32** no. 6 p. 884. Menasha, Wis., 1939. [Recd. 1940.]

A comparison was made of the toxicity of lead arsenate to larvae of *Laphygma* (*Prodenia*) *eridania*, Cram., that had been reared to the fifth instar on young cabbage leaves, old cabbage leaves, and leaves of sweet potato, squash and polk weed (*Phytolacca rigida*). The larvae reared on old and young cabbage leaves were about equally susceptible, but

those reared on the other food-plants were definitely more resistant, particularly those reared on polk weed. Not only was mortality less, but the larvae ate more.

THOMAS (C. A.) & HORSFALL (J. L.). **A Method for studying the Fauna of Mushroom Manure.**—*J. econ. Ent.* **32** no. 6 p. 885. Menasha, Wis., 1939. [Recd. 1940.]

A description is given of a method of examining the live and dead insect and mite fauna of the manure of mushroom beds. Samples of manure from the bed were placed in a can with a 16-mesh screen bottom in a bucket of water in which a wetting agent had been dissolved. After the manure had been stirred for about 5 minutes in this solution, the can retained only the coarser particles, which were discarded. The suspension in the bucket was then allowed to settle for 5 minutes, after which the liquid was poured off and the residue transferred to a beaker and again allowed to settle. The liquid was again removed, and the residual material was poured into a Petri dish in a thin layer and examined under the microscope.

ESSIG (E. O.). **The Golden Codling Moth,** *Carpocapsa pomonella* **(L.) var.** *simpsonii* **Busck.**—*J. econ. Ent.* **32** no. 6 pp. 885–886, 2 refs. Menasha, Wis., 1939. [Recd. 1940.]

Records are given of the finding of a few individuals of the light-coloured form (var. *simpsoni*, Busck) of *Cydia* (*Carpocapsa*) *pomonella*, L., among many thousands of the typical form in Idaho, Colorado and California.

DAMBACH (C. A.). **A collecting Net with a detachable Zipper Bag.**—*J. econ. Ent.* **32** no. 6 pp. 886–887, 3 figs. Menasha, Wis., 1939. [Recd. 1940.]

Several common methods of handling insect specimens collected by sweeping to sample populations were found unsatisfactory because too much time was lost in killing and removing the collected material from the net. A more rapid method was devised by the construction of a sweeping net with an open end to which one of a series of bags was attached with a zip fastener. This net, the construction of which is described, proved very satisfactory for collecting samples in woody or herbaceous field borders. Several hundred samples of 50 sweeps each were taken with this net during the summer of 1939. There was little loss of time between samples, since it was necessary only to replace a detachable bag after each sample was taken.

SCHAFFNER, jr. (J. V.). *Neodiprion sertifer* **(Geoff.), a Pine Sawfly accidentally introduced into New Jersey from Europe.**—*J. econ. Ent.* **32** no. 6 pp. 887–888, 1 ref. Menasha, Wis., 1939. [Recd. 1940.]

In February 1937, a sawfly of which the larvae had been found in abundance feeding on the foliage of varieties of *Pinus mugo* (*montana*) in New Jersey in May 1925 and 1926 was recognised as the European

species, *Neodiprion sertifer*, Geoff. [*R.A.E.*, A **26** 580]. Extensive surveys in May 1937 and May 1938 showed it to be well established in 6 counties. In September 1937, sawflies from Ohio were identified as the same species, and in July 1938, it was reported attacking the mature growth of *P. resinosa* in Michigan. Observations in New Jersey indicate that *P. resinosa*, *P. sylvestris*, *P. densiflora*, *P. banksiana* and *P. mugo* are the most favoured food-plants; light feeding was observed on *P. strobus* and *P. austriaca* where these pines were growing near the more favoured ones, but no larvae were found on *P. rigida*. Severe defoliation was reported in 1937, and the infestation has continued in epidemic form where control measures have not been used. The spread of *N. sertifer* has certainly been retarded by the scarcity of pines round the locality where it was first established and by the spraying programme carried out between 1921 and 1930 against *Lymantria* (*Porthetria*) *dispar*, L.

There is one generation annually. The adults usually emerge in September and October, and the females deposit their eggs singly in slits in needles of the current year's growth, 1–10 or more eggs occurring in one needle. The larvae hatch late in April or early in May, and feed gregariously on the mature foliage. They become full-grown late in May or early in June and spin their cocoons in the litter of the forest floor or occasionally on the twigs, particularly on *P. resinosa* beneath the male catkins. The egg, larva, cocoon and adults of both sexes are briefly described.

CUTRIGHT (C. R.). **Comstock's Mealybug, *Pseudococcus comstocki* (Kuw.), on Apple in Ohio.**—*J. econ. Ent.* **32** no. 6 p. 888, 1 ref. Menasha, Wis., 1939. [Recd. 1940.]

Pseudococcus comstocki, Kuw., which has been recorded from apple in several eastern States [*R.A.E.*, A **13** 567; **24** 722] but was not known to have been found on this food-plant west of the Alleghenies, was taken in an apple orchard in southern Ohio in August 1939. About 60 acres were infested, and the crop from 80 large trees was almost a total loss, owing to the heavy growth of black fungus following the deposition of honeydew. When the fungus grew at the stem end, it was frequently followed by soft rot.

FLANDERS (S. E.). **The Propagation and Introduction of *Coccophagus heteropneusticus* Comp., a Parasite of Lecaniine Scale Insects.**—*J. econ. Ent.* **32** no. 6 pp. 888–890, 4 refs. Menasha, Wis., 1939. [Recd. 1940.]

Coccophagus heteropneusticus, Comp., a gregarious parasite of various Lecaniine Coccids, was reared from *Saissetia oleae*, Bern., and *S. coffeae*, Wlk. (*hemisphaerica*, Targ.) in Brazil and Argentina and was shipped to California in 1934–35 [*R.A.E.*, A **28** 374]. In the insectary at Riverside, it reproduced in *Coccus hesperidum*, L., and *C. pseudomagnoliarum*, Kuw., and its life-history was studied in *S. oleae*. The egg, larval and pupal stages lasted 3, 9 and 8 days, respectively, at about 80°F.

Solitary third-instar larvae developing in immature individuals of *S. oleae* form a membranous cocoon, distended with air obtained through connections with the host's tracheae, to protect them from the moist viscera of the host. Pupation does not occur until the viscera

have been consumed or become desiccated. In certain conditions, the eggs were always deposited in the lumen of the mid-gut. If such eggs hatch, the larvae must immediately work their way into the body cavity, as few were found in the mid-gut. In an experiment in which half-grown individuals of *S. oleae* were exposed to parasites and dissected at intervals over a period of 11 days, eggs were found only in the mid-gut. No larvae were found, and embryonic development was incomplete. An examination of immature scales that had apparently ceased to develop showed parasite eggs in the mid-gut of nearly all. These eggs were apparently disintegrating, possibly because the hosts were not developing under normal conditions. In mature scales, the eggs are deposited less frequently in the mid-gut, and in *Coccus hesperidum*, they are deposited free in the body cavity. In the latter host, however, some eggs were found encysted by phagocytes. Dissections of parasitised *S. oleae* gave no indication of any such defensive reaction.

In shipments of *S. oleae* from South America in which parasites of mealybugs were not included, nearly all the adults of *Coccophagus heteropneusticus* reared were females, whereas in shipments that included parasitised mealybugs (*Pseudococcus citri*, Risso), males predominated in the proportion of 2 : 1. The parasites from *P. citri* were all males and those from *S. oleae* nearly all females. Males from *P. citri* were identical with those that occasionally issued from *S. oleae*, except that the latter were smaller and less robust. Further examination showed that the males were developing as ectoparasites on *Anagyrus pseudococci*, Gir., an internal parasite of *P. citri* [*cf.* **24** 664, etc.]. Eggs laid by unmated females were attached firmly to the outer surface of a primary parasite larva that had constructed its cocoon within a scale or mealybug and on which the larvae fed ectoparasitically, and the adults produced were all males, whereas the same females after mating deposited their eggs free in the body fluids of *S. oleae*, where the larvae on hatching fed endoparasitically, and the adults developing from these larvae were all females. The morphological differences between the eggs and larvae of the two series are compared. There is less mortality during development and less variation in the duration of the life-cycle in the males. The prolongation of female development, which may be brought about by the necessity of waiting for the body fluids of the host to dry or by the less nutritious nature of the host, may be of great advantage in the establishment of *C. heteropneusticus*, as it increases the chance of pairing by enabling late-emerging females to mate with the male offspring of early ones. In *Coccus hesperidum*, the immature stages of females of *Coccophagus heteropneusticus* of the same age varied in stage of development from second-instar larvae to pupae. The minimum life-cycle at 80°F. for both sexes was 20 days. Fertilisation thus results in a complete transformation of the oviposition instinct of the female. A male egg deposited in the body fluids of a Coccid by an unfertilised female will not hatch. The deposition of eggs in the mid-gut in the experiment mentioned above can be explained by the fact that the wall of the mid-gut forms, in place of a primary parasite, a membranous tissue suitable for the attachment of male eggs.

Although many generations of *C. heteropneusticus* were reared in the insectary, and hundreds of thousands of paired females were liberated in various parts of southern California, only one generation was observed in the field and the parasite did not become established.

IMPERIAL INSTITUTE OF ENTOMOLOGY.

LIBRARY LACUNAE.

The Institute will be greatly indebted to readers who may be able to supply any of the following, which should be sent to the Assistant Director, Imperial Institute of Entomology, 41, Queen's Gate, London, S.W.7.

BOLETIN DE LA DIRECCION DE ESTUDIOS BIOLOGICAS (MEXICO):
Tomos I–II (1924–25).

BULLETIN AGRICOLE DE L'ALGÉRIE—TUNISIE—MAROC (ALGIERS):
Année XX (1914). Nos. 7–9, 12–14 and Title-page.

BULLETIN DU COMITÉ D'ETUDES HISTORIQUES ET SCIENTIFIQUES DE L'AFRIQUE OCCIDENTALE FRANÇAISE (PARIS): Année 1919, No. 1.

CALIFORNIA AGRICULTURAL EXPERIMENT STATION (BERKELEY, CAL.):
Circulars 14 and 42 (1905–09).

CHACARAS E QUINTAES (SÃO PAULO): Indices to Vols. X, XI, XII, XIV and XLII, No. 3.

COMPTES RENDUS DES SÉANCES DE L'ACADÉMIE D'AGRICULTURE DE FRANCE (PARIS): Tome VIII (1922) No. 5.

EGATEA, REVISTA DA ESCOLA DE ENGENHARIA DE PORTO ALEGRE, BRAZIL:
Vols. I–VI (1916–21); VII (1922) Nos. 1–5; VIII (1923) Nos. 2–5; IX (1924) Nos. 1, 4–6.

ENTOMOLOGICA AMERICANA (BROOKLYN, N.Y.):
Vol. IV (1888) Title-page. Vol. V (1889), Nos. 6 & 8.

ENTOMOLOGISCHE LITTERATURBLÄTTER (BERLIN): 6. Jahrg. (1906). Nos. 2 & 10.

EXPERIMENT STATION RECORD (WASHINGTON, D.C.): Vols. I–IV (1889–94).

GEORGIA STATE BOARD OF ENTOMOLOGY (ATLANTA):
Bulletin: 2, 6, 22 and 28. Circular: 1 to 3, 12, 15 to 18 and 20.

INDIA: FOREST RESEARCH INSTITUTE (DEHRA DUN):
Forest Bulletin (Old Series): Nos. 1–3.

LIBRARY LACUNAE.—*cont.*

INDIAN MEDICAL GAZETTE (CALCUTTA) :
Vol. L (1915) No. 10 : LI (1916) Nos. 1–7, 10 ; LII (1917) No. 7 and title-page & index ; LIII (1918) ; and LIV (1919) No. 2.

INDIANA : Third Annual Report of the State Entomologist, 1909–10.

JOURNAL OF THE BOARD OF AGRICULTURE OF BRITISH GUIANA (DEMERARA) :
Vol. III No. 1 (1909). Title pp. and Indices to Vols. I–II.

JOURNAL OF THE SOUTH-EASTERN AGRICULTURAL COLLEGE (WYE, KENT):
Nos. 1–6, 8, 11–13 (1895–1904).

KENTUCKY AGRICULTURAL EXPERIMENT STATION (LEXINGTON, Ky.) :
Bulletin Nos. 21 (1889), 31 (1890), 47 (1893), 53 (1894), 74 (1898) and 91 (1901).

THE KENYA AND EAST AFRICAN MEDICAL JOURNAL (NAIROBI) : Vol. II Nos. 2–3 (1925).

NATUURHISTORISCH MAANDBLAD (MAASTRICHT) : Jaarg. I (1912) ; II (1913) Nos. 1–4, 6–9 ; V (1916) Nos. 3–4 ; VII (1918) Nos. 6–9 ; VIII (1919) No. 4.

NEW JERSEY STATE DEPARTMENT OF AGRICULTURE (TRENTON, N.J.) : Bulletin 2 ; Circular : 2, 12, 29 (1917–19).

NEW YORK STATE MUSEUM (ALBANY, N.Y.) : Bulletin : 26 & 57 (1899–1902).

ONTARIO ENTOMOLOGICAL SOCIETY REPORT (TORONTO) : 9th (1878).

ORMEROD (E. A.). OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS DURING THE YEARS 1877 & 1878 (London, 1878–79).

PHILIPPINE AGRICULTURIST AND FORESTER (MANILA) :
Vols. II Nos. 1–3 (1912) ; III Nos. 1, 2 (1914) ; IV No. 4 (1915).

PHILIPPINE JOURNAL OF SCIENCE (MANILA) : Vol. I (1906) No. 10.

PORTO RICO DEPARTMENT OF AGRICULTURE, &c. (SAN JUAN) :
Journal, Vol. I (1917) No. 3.

PSYCHE (BOSTON, MASS.) : Vols. XI (1904), XIII (1906), XVI (1909).

RECORDS OF THE EGYPTIAN GOVERNMENT SCHOOL OF MEDICINE (CAIRO) : Vol. I.

REVISTA DE AGRICULTURA DE PUERTO RICO (SAN JUAN) :
Vols. I (1918) Nos. 1–2 ; II (1919) Nos. 5–6 ; III (1919) Nos. 3–4 ; VIII (1922) No. 2 ; IX (1922) Nos. 5–6 ; X (1923) Nos. 1, 5, 6.
Indices to Vol. VI–XVI.

REVISTA CHILENA DE HISTORIA NATURAL (SANTIAGO) : Año XIV (1910) Nos. 4–6 ; XV (1911) Nos. 1 and 3 to end ; XVI, XVIII, XXVI (1912, 1914, 1922).

REVISTA DE VETERINARIA E ZOOTECHNIA (RIO DE JANEIRO) :
Annos I–II (1911–12). Anno III (1913) Nos. 1 to 3, and 5.

LA REVUE DE PHYTOPATHOLOGIE APPLIQUÉE (PARIS) : Tome I Nos. 22–23 (April–May, 1914).

RHODESIA AGRICULTURAL JOURNAL (SALISBURY) :
Vol. I Nos. 1, 3–6 ; II Nos. 2–4 ; III Nos. 1, 2, 6 ; IV No. 4 ; V No. 4 (1903–08) ; VII (1909–10) Nos. 1 & 6 ; IX (1912) No. 5 ; X (1912 No. 1. Title pp. and indices to Vols. I–V, VII, VIII, X.

SCIENCIA MEDICA (RIO DE JANEIRO) : Anno 1 Nos. 2–3, 5–6 ; II Nos. 1–10, 12.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY :
Report, 1879–84.

TENNESSEE AGRICULTURAL EXPERIMENT STATION (KNOXVILLE) :
10th (1897), 12th (1899), and 16th (1903) Annual Reports.

TENNESSEE STATE BOARD OF ENTOMOLOGY (KNOXVILLE) :
Bulletin : 15, 24, 25, 28, 29, 34, 39.

TEYSMANNIA (BATAVIA) : 32ste Jaarg. (1921) 10e Afl.

DE THEE (BUITENZORG) : 6e Jaarg. (1925) No. 1.

TIJDSCHRIFT OVER PLANTENZIEKTEN (WAGENINGEN) :
Jaarg. I (1895) and XVI–XVII (1910–11).

TIMEHRI : THE JOURNAL OF THE ROYAL AGRICULTURAL AND COMMERCIAL SOCIETY OF BRITISH GUIANA (DEMERARA) :
Third Series, Vols. I Nos. 1–2 ; II No. 2 to end ; III Nos. 2 to end; IV–V (1911, 1913–18).

UNITED STATES DEPARTMENT OF AGRICULTURE (WASHINGTON, D.C.) :
Howard (L. O.). Report of the Entomologist, 1895.

VIRGINIA : AGRICULTURAL EXPERIMENT STATION (BLACKSBURG, Va) :
Bulletins 24, 61 (1893–96). Technical Bulletin 8 (1915).

VIRGINIA : 1st ANNUAL REPORT OF THE STATE INSPECTOR FOR SAN JOSÉ SCALE, 1896–97 (Richmond, Va, 1897).
4th Report of the State Entomologist and Plant Pathologist (Richmond, Va., 1905).

WEST INDAN BULLETIN (BARBADOS) : Title-page & Index to Vol. IV.

ZEITSCHRIFT FÜR DAS LANDWIRTSCHAFTLICHE VERSUCHSWESEN IN ÖSTERREICH (Vienna) : 21. Jahrg. (1918) Hefte 1–3 & 10–12.

NOTICES.

Secretaries of Societies and Editors of Journals willing to exchange their publications with those of the Institute are requested to communicate with the Assistant Director.

The Annual Subscription, *in advance*, to the Review, Series A (Agricultural), is 30s. post free; Series B (Medical and Veterinary), 15s. post free. Subscriptions to the *current* Volume received after 30th June in each year will be charged at the published price *viz.*: Series A, 36s.; Series B, 18s. Prices of Back Volumes on application.

Orders and subscriptions should be sent direct to the Assistant Director, Imperial Institute of Entomology, 41, Queen's Gate, London, S.W.7, or through a bookseller.

CONTENTS.

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE
by the South Essex Recorders, Ltd., Ilford.

(1940) Wt. P4/3692 1,700 10/40 S.E.R. Ltd. **Gp. 432.**